Panama Maritime Authority
Directorate General of Merchant Marine
Maritime Affairs Investigation Department

M/V "EVER GIVEN"
IMO No. 9811000
R-026-2021-DIAM
CASUALTY DATE: March 23rd, 2021

MARINE SAFETY INVESTIGATION REPORT

GROUNDING

OF

MV EVER GIVEN

AT

SUEZ CANAL EGYPT

ON

MARCH 23, 2021

DISCLAIMER

The investigations should not be used to exert criminal, civil or administrative actions, in which they will be subject only to the purposes stated in the ***Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code)*** Chapter 1 and which is adopted by the International Maritime Organization (IMO).

Law: Resolution No. 106-257-DGMM of December 09, 2020

General Directorate of Merchant Marine

Panama Maritime Authority

Note: This investigation report should not serve for any future claim or liability.

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Abbreviations:

ABS	American Bureau of Shipping	**LBP:**	Length between Perpendiculars
BF:	Beaufort Wind Force Scale	**LOA**	Length Overall
BHP:	Brake Horse Power	**M/E:**	Main Engine
COC:	Certificate of Competency	**MSC:**	Maritime Safety Committee
COE:	Certificate of Endorsement	**Mts**	Meters
C/O	Chief Officer	**MT**	Metric Tons
DPA:	Designated Person Ashore	**MSM:**	Minimum Safe Manning
ECR	Engine Control Room	**M/V:**	Motor Vessel
E/R:	Engine Room	**NM:**	Nautical Miles
ETA:	Expected Time of Arrival	**O/B:**	On Board
ETD	Expected Time of Departure	**PMA:**	Panama Maritime Authority
DGMM:	General Directorate of Merchant Marine (Panama)	**P&I:**	Protection and Indemnity Club
GPS:	Global Positioning System	**R.O.:**	Recognized Organization
GRT/NET:	Gross Registered Tonnage / Net Registered Tonnage	**PSC:**	Port State Control
HRS / LT:	Hours / Local Time	**RPM:**	Revolutions per Minute
IMO:	International Maritime Organization	**SMS:**	Safety Management System
ISM:	International Safety Management	**SOLAS**	Safety of Live at Sea
KW:	Kilowatts	**STCW:**	Standards of Training Certification and Watch keeping

Objective:

The present report has been elaborated to meet all the requirements and guidelines established by the marine casualty investigation code (**IMO resolution MSC 255-84**) and the Panama National Legislation (**Resolution 106-257-DGMM / December 9th 2020**), in order to describe and analyze, as clear as possible the casualty under investigation, to establish its causes and lead to proper recommendations to improve safety and save human lives.

The main objectives of the present report can be defined as following:

1. Appreciate the importance of intervention in hazardous situations.
2. Identify the causes that led to this incident.
3. Understand how to prevent such incidents from re-occurred.

This investigation is conducted only for the safety point of view and in order PMA to offer recommendations and contribute in maritime safety by introducing the appropriate protective / preventing measures, in order to minimize possibility of similar Marine Casualties to be re-occurred in future.

This investigation has not been conducted with the purpose of determine liability, or to apportion blame, not is to be considered in any case a presumption of guilt or responsibility. The content's election and the report's style cannot be used for any judicial proceedings.

The present report is configured as follows:

1. General description of vessel and crew.
2. General description of voyage and environmental conditions.
3. General description of casualty.
4. Analysis (Sequence of events, main causes, underlying factors, human errors).
5. Conclusions.
6. Recommendations.

In the present report, time is represented in a 24 hrs local time format

Executive Summary:

In the early hours of Tuesday, **23 March 2021**, the 20,000 TEU containership **M/V EVER GIVEN** grounded whilst transiting northbound through the Suez Canal. The grounding occurred in an area where traffic cannot pass in both directions, having as a result the closure of the Canal and an increasing backlog of ships waiting to transit. On **25 March 2021**, Lloyd's List reported 230+ ships **were in the queue** and by **29 March 2021** that number had risen to 429.

In particular, vessel entered the Suez Canal approach channel and the first part of the transit was uneventful. The pilots boarded (as per Master statement) on about **07:16 HRS / LT**, the pilots conducted a handover on about **07:20 HRS / LT**, and the first pilot departed afterwards. The two new pilots remained, one was providing direct conning orders, the other was observing and monitoring. At around the time that the pilots changed over, the wind speed increased and visibility was severely reduced with sand for couple of minutes, and pilots had difficulty maintaining position in the center of the channel. The pilot ordered additional full ahead to increase speed and assist with steering. This order was complied with and the speed was increased to 12 Knots (GPS) over the ground (48 RPM).

After the wind had increased, the pilot was issuing more helm orders to the helmsman. These were either for **hard to port or for hard to starboard, with no midships or lesser helm orders in between**.

At about **07:38 HRS / LT**, the helmsman reported that the vessel had stopped turning to port and was starting to turn to starboard. At the time, the vessel was close to the port bank of the canal and the speed had increased to about 13 knots over the ground. The vessel then started to turn quickly to starboard, away from the port bank. The pilot initially ordered the rudder to port 20 degrees and then hard to port to stop the vessel from turning. Then the second pilot started communicates with the first pilot in local language.

The first pilot reduced speed to half ahead and the vessel continued to turn to starboard. There was another communication between the two pilots in Arabic language and the main engine was increased to full ahead again. The vessel continued to turn starboard, towards the starboard canal bank. The pilot again ordered hard to port presumably to try to steady the heading but vessel continued turning to starboard side. The main engine revolutions were increased to Nav full ahead (53 RPM) but still the vessel was swinging heavily starboard. The vessel continued this swing and grounded at a speed of about 12 knots over the ground on the eastern bank of the canal at **07:41 HRS / LT**, at location **30 01.059N / 032 34.810E, at 151 KM of Suez Canal.**

1.0 About Vessel & Crew Members:

1.1 Vessel General Information & Particulars:

M/V EVER GIVEN is a Panama registered container vessel. The vessel is owned by "HIGAKI SANGYO KAISHA LTD 90% / JAPAN" & "LUSTER MARITIME S.A. 10% / PANAMA" and managed by "BERNHARD SCHULTE SHIPMANAGEMENT (HONG KONG) LIMITED PARTNESHIP / HONK KONG"**.** She was delivered on 2018 by IMABARI SHIPBUILDING CO., LTD, JAPAN, and was classified by ABS, statutory certificates, including SMC/ISSC/MLC have been issued from "R.O." ABS.

M/V EVER GIVEN had an overall length of 399.98 (m) and a breadth (moulded) of 58.80m. She was designed with 11 cargo holds and has a stowage capacity of containers 20.124 (including 1.273 Reefers) Propulsive power is provided by one main engine "MITSUI MAN B&W / Type 11G95ME-C9.5" developing a total output of 53,370,000 kW @ 76.3 RPM, driving one x 6 blade solid type propeller, Diam 10,250mm, Pitch 9661,50mm @0.7R/9431,50 mm. Navigational (consistent with SOLAS requirements) and GMDSS communication equipment are located in the Ship´s Bridge.

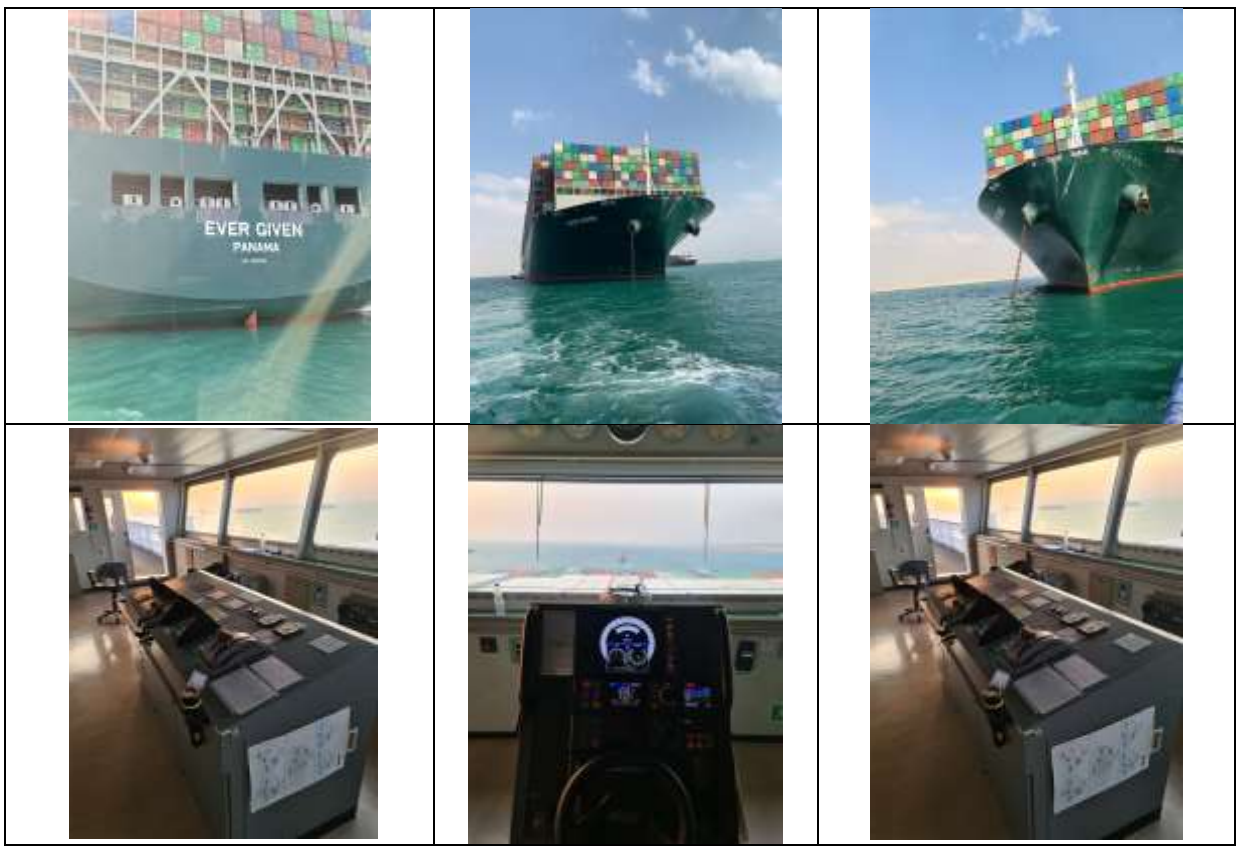


FIGURE 1: EVER GIVEN VIEW HULL / BRIDGE
(Source: Photos taken during physical attendance o/b)

The vessel's identification details and main particulars are shown in below table

Ship's Name	**EVER GIVEN**
IMO No	**9811000**
Call Sign	**H3RC**
Flag	**Panama**
Port of Registry	**Panama**
Class	**ABS**
Type of Ship	**Container Ship**
Date of Build	**2018**
Shipyard	**IMABARI SHIPBUILDING JAPAN**
Owners	**HIGAKI SANGYO KAISHA LTD 90% / JAPAN" & "LUSTER MARITIME S.A. 10% / PANAMA**
Operators	**BERNHARD SCHULTE SHIPMANAGEMENT (HKG)**

DIMENSIONS	
Gross Tonnage	**219079 Tons**
Net Tonnage	**99155 Tons**
Deadweight (summer)	**198886 Tons**
Length O.A. / B.P.	**399.98 / 387.00 Meters**
Breadth (MLD)	**58.80 Meters**
Depth (MLD)	**32.90 Meters**
Freeboard (Summer)	**10.226 Meters**
Draft (Summer)	**16.025 Meters**

MACHINERY	
M/E Type	**11G95ME-C9.5**
Manufacture	**MITSUI MAN B&W**
Power	**MRC 53,370KW@76.3 RPM**
Bow / Stern Thruster	**2 Skewed type, CPP 4 blades, 2400KW**
Propeller	**1 x 6 Blade solid type, diameter 10250mm**
Service Speed	**22,8 knots**

CAPACITIES	
Cargo Holds	**11**
Total Capacity	**20124**
FO (heavy) Capacity	**13,318.58 m^3**
DO Capacity	**1431.87 m^3**
FW Capacity	**433.60 m^3**
BW Capacity	**61,419.53 m^3**

TABLE 1: VESSEL MAIN PARTICULAR
(Source: Vessel Certificates / Class records)

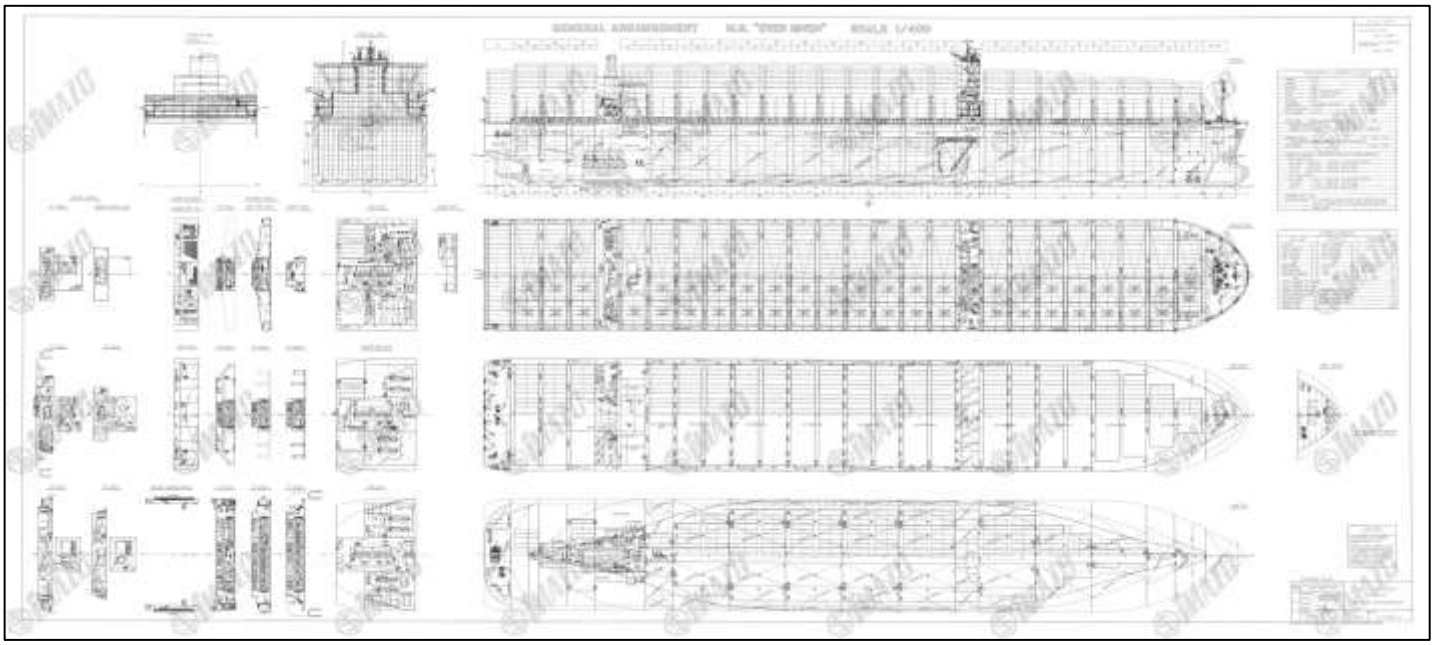


FIGURE 2: GENERAL ARRANGEMENT PLAN
(Source: Plan submitted by Master during physical attendance o/b)

1.2 Ship's Licenses and Certificates (Flag / Class & Statutory):

Vessel during grounding incident, on **23 March 2021**, has been reported to be with valid trading certificates. Additionally, during the process of the casualty investigation inspection, all vessel registry, statutory and class certificates examined / reviewed and found valid, as per below table.

Class & Statutory Certificates			
TYPE	ISSUED BY	EXPIRY (E) OR ISSUED (I)	LAST SURVEY
CLASS	ABS	24/09/2023 (E)	09/09/2020
IAPP	ABS	24/09/2023 (E)	09/09/2020
IOPP	ABS	24/09/2023 (E)	04/12/2020
ISPP	ABS	24/09/2023 (E)	17/05/2020
CSSE	ABS	24/09/2023 (E)	04/12/2020
CSSR	ABS	24/09/2023 (E)	09/09/2020
CSSC	ABS	24/09/2023 (E)	09/09/2020
ILL	ABS	24/09/2023 (E)	09/09/2020
ITC-69	ABS	13/05/2020 (I)	-
ISSC	PMA	09/02/2024 (E)	10/02/2019
SMC	ABS	31/01/2024 (E)	01/02/2019
MLC	ABS	09/02/2024 (E)	10/02/2019
DOC	DNV	03/04/2022 (E)	20/05/2020
IHMC	ABS	09/09/2020 (I)	24/09/2023
CICA	ABS	25/09/2018 (I)	-
DOC for Dangerous Goods	ABS	24/09/2023 (E)	04/12/2020

Registry Certificates			
TYPE	ISSUED BY	EXPIRY (E) OR ISSUED (I)	LAST SURVEY
Navigation Registry	PMA	09/09/2025 (E)	-
MSM	PMA No 046153	19/05/2020 (I)	-
Radio Station License	PMA	20/05/2025 (E)	-
WRC	PMA	28/01/2021(E)	-
CSR	PMA No 2	21/03/2019 (I)	-

TABLE 2: VESSEL FLAG / CLASS / STATUTORY CERTIFICATES
(Source: Vessel Certificates / Class Status)

In addition, to the review and evaluation of vessel certificates, as per above table, class status report was also examined, and vessel found free of any defects or class conditions, affecting vessel seaworthiness.

1.3 Crew Members:

Whole ship´s crew consisted of 25 persons (Indian Nationality) including Master, therefore effective and efficient communication between crew members was observed. All officer's documentation {including National licenses, Medical fit certificate, Panama endorsements, and training certificates (including ECDIS specific / generic)}, presented / reviewed / examined and found in compliance with the SCTW, Flag State requirements and their positions and duties on board.

In addition to the review of crew members certificates, SEA examined and found that all crew were provided with valid SEA. Crew working / resting hrs, were reviewed and found in line with MLC regulations. Familiarization and safety drill records reviewed and found to be in line with company SMS procedures and safety drill timetable. In addition to the crew certificates & familiarization records, the drugs and alcohol records, available o/b, were examined / reviewed, and it was noted that crew-members have undertaken an unscheduled alcohol test and were found free of alcohol.

MSM Requirements		**Crew on-board as per crew list**	
Capacity / STCW / Number		Capacity / STCW / Number	
✓ Master (II/2)	One (1)	✓ Master (II/2)	One (1)
✓ Chief Mate (II/2)	One (1)	✓ Chief Mate (II/2)	One (1)
✓ Deck Officer (II/1)	One (1)	✓ Deck Officer (II/1)	Two (2)
√ AB Seaman (II/4)	Three (3)	✓ Junior 3rd Deck Officer	One (1)
✓ O/S (VI/1)	One (2)	✓ AB Seaman (II/4)	Four (4)
✓ Chief Engineer	One (1)	✓ O/S (VI/1)	Four (4)
✓ Second Engineer	One (1)	✓ Chief Engineer	One (1)
✓ Engineer Officer	One (1)	✓ Engineer Officer (2nd)	One (1)
✓ Oilers / Motorman	One (3)	✓ Engineer Officers	Two (2)
		✓ Oilers / Motorman	Two (3)
		✓ Cook / Catering	Two (2)
		✓ ETO	Two (2)
		✓ Fitter	One (1)

The MSM certificate has been issued from PMA, identifying the minimum competency and manning requirements. The requirements of Minimum Safe Manning at the time of the incident have been fulfilled as per vessel crew list. Following table shows requirements of Minimum Safe Manning and crew on board.

TABLE 3: MANNING DETAILS
(Source: MSMC / Crew List)

1.4 Port State Control (PSC):

In order to evaluate the overall condition of vessel, the leaving environment o/b, the performances of crewmembers and the working conditions, PSC inspection records, for the last three years, prior grounding, were reviewed and examined, as following.

Authority	Port of inspection	Date of report	Detention	PSC Organisation	Type of inspection	Duration (days)	Number of deficiencies	Details
United Kingdom	Felixstowe	27/02/2020	N	Paris MoU	Initial inspection		3	
China People's Republic	Shanghai	20/08/2019	N	Tokyo MoU	Follow-up inspection			
				Tokyo MoU	Initial inspection		3	
Netherlands	Rotterdam	11/02/2019	N	Paris MoU	More detailed inspection			
Hong Kong, China	Hong Kong Marine Department	13/12/2018	N	Tokyo MoU	Initial inspection		1	
Germany	Hamburg	07/11/2018	N	Paris MoU	Initial inspection		2	

FIGURE 3: PORT STATE CONTROL INSPECTIONS RECORDS (2018-2020)
(Source: Equasis)

Having review PSC inspection records, dated prior the grounding / incident, it was noted that vessel records for years **2018-2020** (up to October) were satisfactory, with zero detentions. Moreover, last PSC inspection was conducted on **27 Feb 2020** from MCA, at FELIXSTOWE port with three deficiencies, as per below figure.

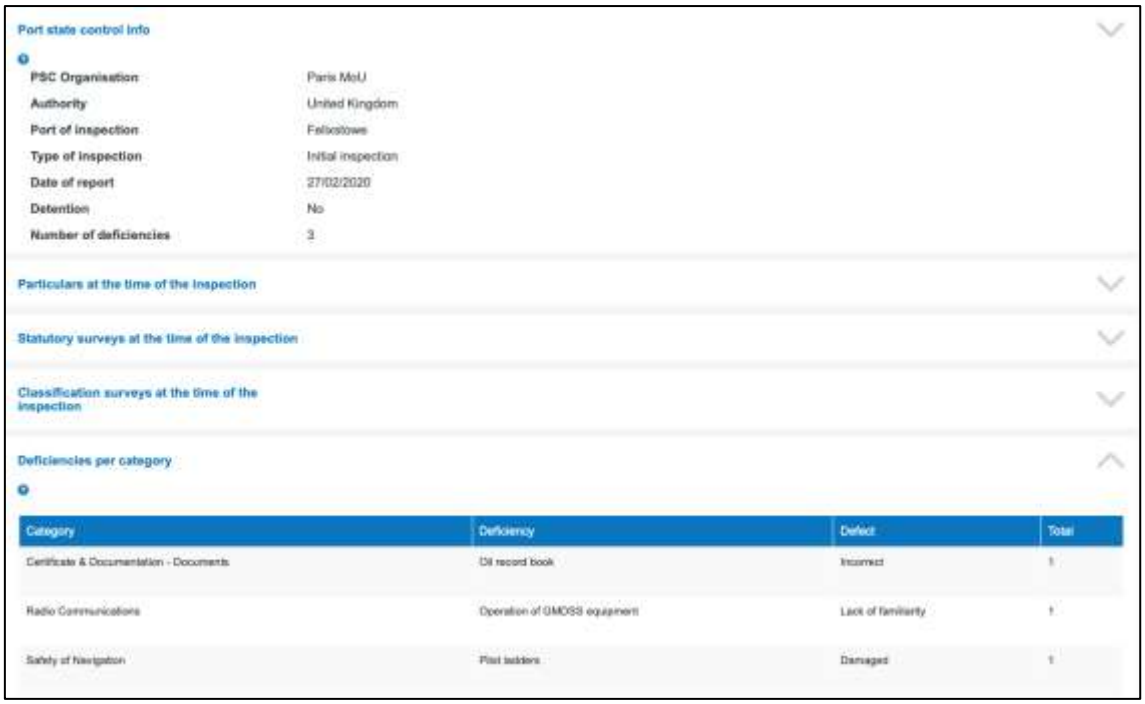


FIGURE 4: LAST PSC - MCA INSPECTION RECORDS
(Source: Equasis / PSC report available o/b)

2.0 Particulars of Voyage and Environmental Conditions

2.1 Particulars of Voyage:

At **13.03.2021** vessel sailed from Tanjung / Pelapas, Malaysia, voyage Number 011W loaded with containers bound for Rotterdam, Holland. Total cargo o/b was 167,908 MT tons as per below print out from Loadstar system, available o/b.

LOADOMETER by NDES v. NET 1.1 — Tue Mar 23 2021 08:25
EVER GIVEN (MFG:S21881878)
ARRIVAL SUEZ 011W 22MAR2021.mxml — Page 1 of 8

Condition Summary

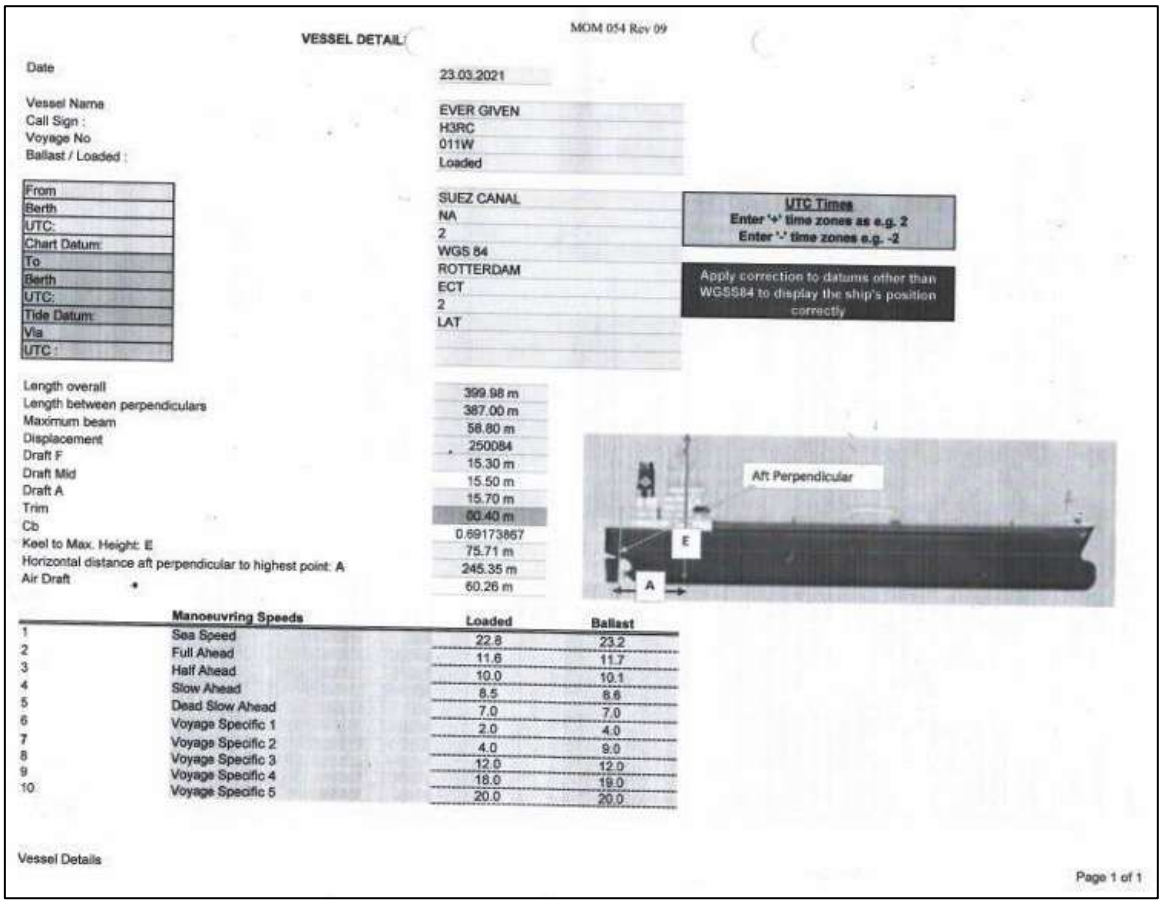
Vessel name: EVER GIVEN		Voyage No:011W	
Current POL: MYTPP			call:2
Next POL: NLRTM			call:3
ETD		ATD	
ETA		ATA	
Description:			
Density of Seawater:	1.0250 t/m3		
WATER BALLAST	9221 t		
FUEL OIL	2402 t	Draught Fore (P)	15.19 m
DIESEL OIL	424 t	Draught Mid (P)	15.06 m
FRESH WATER	340 t	Draught Aft (P)	15.70 m
LUB. OIL	92 t	Trim	0.51 m
		GM' (corrected)	2.49 m
		GM Limit	0.81 m
		GM Reserve	1.68 m
		Max. rel. BM (Sea)	85 %
Dead Load	0 t	Max. rel. SF (Sea)	73 %
Stores / Misc.	1625 t	Max. rel. TM (Sea)	49 %
		Lever Balance	OK
Container	167645 t	Deadweight	181750 t
	18349 TEU	Light Ship	66990 t
No. of Containers	10788	Displacement	248740 t

Lash : GM=2.49 m (StabCalc), D=15.19 m (StabCalc), V=18.0 knots

Master: _____ Ch.Officer: _____

FIGURE 5: LOADMASTER PRINT OUT
(Source: Record provided from Master)

Voyage No 011W between Tanjung / Pelapas, Malaysia to Rotterdam / Holland, via Suez Canal was planned as per below voyage plan, prepared by 2nd D/O, reviewed / approved by Master.



VESSEL DETAIL

MOM 054 Rev 09

Date	23.03.2021
Vessel Name	EVER GIVEN
Call Sign :	H3RC
Voyage No	011W
Ballast / Loaded :	Loaded
From	SUEZ CANAL
Berth	NA
UTC:	2
Chart Datum:	WGS 84
To	ROTTERDAM
Berth	ECT
UTC:	2
Tide Datum:	LAT
Via	
UTC :	

UTC Times
Enter '+' time zones as e.g. 2
Enter '-' time zones e.g. -2

Apply correction to datums other than WGS84 to display the ship's position correctly

Length overall	399.98 m
Length between perpendiculars	387.00 m
Maximum beam	58.80 m
Displacement	250084
Draft F	15.30 m
Draft Mid	15.50 m
Draft A	15.70 m
Trim	00.40 m
Cb	0.69173867
Keel to Max. Height: E	75.71 m
Horizontal distance aft perpendicular to highest point: A	245.35 m
Air Draft	60.26 m

	Manoeuvring Speeds	Loaded	Ballast
1	Sea Speed	22.8	23.2
2	Full Ahead	11.6	11.7
3	Half Ahead	10.0	10.1
4	Slow Ahead	8.5	8.6
5	Dead Slow Ahead	7.0	7.0
6	Voyage Specific 1	2.0	4.0
7	Voyage Specific 2	4.0	9.0
8	Voyage Specific 3	12.0	12.0
9	Voyage Specific 4	18.0	19.0
10	Voyage Specific 5	20.0	20.0

Vessel Details

Page 1 of 1

FIGURE 6: VOYAGE PLAN
(Source: Record provided from Master)

Item	Data
Port of Departure:	Tanjung / Pelapas - Malaysia via Suez Canal
ETD:	13.03.2021 (Tanjung / Pelapas) – 23.03.2021 (Suez)
Port of Arrival:	Rotterdam - Holland
Estimated average Speed:	18 Knots
Cargo:	167,908 MT

TABLE 4: VOYAGE DETAILS
(Source: Voyage plans records provided from Master)

2.2 Environmental Conditions at the time of Grounding / Incident:

Following weather information table is based on the data from weather condition reports, and form data provided from Master.

Item	Data
Wind Direction:	S'LY
Wind Speed:	25-27 knots with wind gusts to 40 knots
Sea Direction:	S'LY
Sea Force:	6 BF scale
Visibility:	Over 5 miles
Time of Day:	Day

TABLE 5: ENVIROMENTAL CONDITION
(Source: VDR and Master report)

3.0 Casualty Particulars:

The main details of the Marine Casualty are listed below

Item	Data
Vessel Name:	EVER GIVEN
Casualty:	Vessel striking / grounding eastern bank of the Suez Canal, at location 30 01.059 N / 032 34.810 E, at 151 KM of Suez Canal.
Time and date of casualty:	**07:41 HRS / LT** **23.03.2021**
Location of casualty:	**30 01.059 N / 032 34.810 E**, at 151 KM of Suez Canal.
Number of crew:	
Damage / Loss:	Hull damages / Blocking Suez Canal
Number of fatalities / injuries:	Nil
Intended track:	Vessel was in transiting Suez canal
Course:	352 Deg
Speed:	About 12 Knots

TABLE 6: CASUALTY PARTICUALARS
(Source: VDR and report analysis)

4.0 Geographical Location of the Casualty:

4.1 General Information of the Suez Canal:

The Suez Canal is an artificial sea-level waterway in Egypt, connecting the Mediterranean Sea and the Red sea. The canal separates the African continent from Asia and it provides the shortest maritime route between Europe and South Asia.

The total length of Suez Canal is 193.3 Km, and is owned and managed by Suez Canal Authority.

Suez Canal may be divided into three main sectors as follows:

A- Northern Sector; this part is located between the port said and the Great Bitter Lakes.
B- The Lakes; Timsah and Great Bitter Lakes.
C- Southern Sector; this part is located between port Suez and the Bitter Lakes.

The Egyptian government launched construction in 2014 to expand and widen the Ballah Bypass for 35 km (22 mi) to speed up the canal's transit-time. The expansion intended to nearly double the capacity of the Suez Canal. The "New Suez Canal", as the expansion was dubbed, was opened in a ceremony on 6 August 2015.

Rules of Navigation for Suez Canal:

As per Suez Canal Authority procedures, every ship transits the canal, should be provided and comply with "Rules of Navigation for Suez Canal".

During the physical inspection o/b, vessel found to be provided with "Rules of Navigation for Suez Canal" edition 2015. Moreover, as per Master statement, he had verified with his company, and he has received confirmation that edition 2015 was the edition available O/B.

In order to verify that vessel was provided with the edition of "Rules of Navigation for Suez Canal", following actions conducted.

1. Egyptian authority casualty investigator has been requested to verify the edition O/B, and he has confirmed that the one available o/b is edition of 2015.
2. Pilot duties (please refer to Figure 15 point a) is to ensure that vessel follows the applicable "Rules of Navigation for Suez Canal". During physical inspection o/b, and review of docs exchanged between pilots and bridge team, it was not observed any kind of remark / note from pilots regarding the edition 2015 of "Rules of Navigation for Suez Canal".
3. Subsequently, it was verified on the official website and the published regulation is that of 2020, therefore it follows that the ship did not have the latest edition of the Rules of Navigation for Suez Canal on board.

Main points of "Rules of Navigation for Suez Canal", related with the incident are described herein below:

- Transit of the Canal is arranged with the vessels in a convoy pattern. Traffic system in the Suez Canal including the new Canal shall be as follows:
- a) Number of convoys: Two convoys
  - - The Southbound convoy starts at 03:30- direct transit.
  - - The Northbound convoy starts at 04:00- direct transit.
- b) Limit Time of Arrival
  - - Port Said: South of lat. 31 28 .7 N Limited by long. 32 37.43 E. at 2300.
  - - Port Tewfik. North of lat. 29 42. 8 N. limited by long. 32 23 .1 E & Long. 32 41 .5 E. at 2300.
- Pilotage is compulsory for all vessels, whatever is their tonnage when entering, leaving, moving, changing berth or shifting on Canal Waters or Port Said and Suez harbors.
- Vessels transiting the Canal must have mooring boats hired from the Suez Canal Mooring Company approved by SCA. Ships of 30,000 GRT and over are required to have two motor mooring boats.
- When under way in Canal Waters, the vessel shall keep a full watch in the bridge and in the engine room, as well as anchor watch.
- The permissible speed shall be as follows: a) 16 km / hr (8,64 Knots) for ordinary vessels b)14 km / hr (7,56 Knots) for Tankers.
- As per Art., 58 Escorting Tugs: The escort of VLCCs, ULCCs, L.P.G, L.N.G, large Bulk Carriers and other vessels, except Container Ships less than 170000 SC.N.T will be as follows. Important point is number 10; Container Ships of 170000 SC.N.T and more will be escorted by 2 tugs.

Note: According to the special tonnage certified for the Suez Canal of the MV Ever Given, the Gross Register Tonnage is 222132 and the Net Register Tonnage is 208995. Therefore, according to the Art., 58 Escorting Tug regulations, the ship had to carry out the transit with 2 tugs to comply with the Rules of the Suez Canal.

4.2 Location of Vessel Grounding:

The canal width is of particular relevance for this incidence. At its surface the canal is about 313 m wide, however its construction profile means that the sloping sides give a width of about 225m at 11 meters draft, decreasing to about 121 m bottom width. Thus, at 400m such ships are significantly longer than the navigable width of the canal waterway.

5.0 Description of Maritime Casualty:

Narrow canals, like Suez canals are areas with high potential of navigational risk. The limited area of navigation can result in collisions between vessels, and the shallow water can lead to bank interaction squat effect or combination of them. Additionally, poor advice followed or given by pilots may also lead to marine incidents. Another factor that can lead to marine incidents is the poor practice and the ignorance of Navigation.

The Suez Canal is an area where particular care is needed during navigation. For this reason, while transiting, vessels required having pilot onboard and the entire bridge team should be alert.

During vessel canal transit on the bridge was Master, Chief Officer, one AB (as helmsman), Junior officer and canal pilots. All of the crew members were sufficient experienced, familiarized with bridge equipment, and as per SMS records they had sufficient rest hrs (in line with STCW requirements).

Additionally, as per SMS records and VDR, data all navigation equipment was in good order, and thorough passage plan / bridge team meeting have been carried out. Exchange of information between the pilots and Master was conducted / concluded with satisfactory results.

5.1 Analysis of Casualty / Sequence of events:

The following sequence of events is based on VDR Analysis, evidences collected during physical inspection o/b, Master statements of fact, and crew members interviews involved with the vessel grounding.

On **23 March 2021**, the vessel dropped anchor at E16 anchorage south of the Suez Canal at about **00:24 HRS / LT**, in accordance with instructions received from Port Control. The weather at that time reported to be calm with light winds. At that time, and in accordance to vessel SMS records as well as VDR data, all navigational & machinery equipment, were in good order without any defects or any error alarms.

After anchoring, Master went down from the bridge to address needs for quarantine, agents and Canal Authorities to process vessel arrival and transit paperwork.

At about **02:30 HRS / LT**, Master heard the sound of a wind howling outside the vessel and he called bridge to check the situation. The OOW informed Master that the wind is gusting up to 35 knots. Master proceeds to bridge and noted the wind was from a southerly direction and the anchor cable was stretching to maximum.

Due to the above situation, Master instructed Duty Engineer to prepare Engines, and Bridge Team was alerted accordingly. After the engines were available, Master observed that vessel had started to slowly drag Anchor in a northerly direction, due to

strong winds. Hence, he commenced heaving up anchor whilst using Engine and Bow thruster to maintain safe position.

At that time Master observed on the radar that the adjacent vessel, AL NASRIYAH (similar size/type vessel) on vessel stbd was dragging her anchor. Master, immediately contacted AL NASRIYAH on VHF, in order to inform them for the dangerous situation, and OOW from AL NASRIYAH replied that they were using engines to keep her in position. When the vessel anchored aweigh, the Master informed port control that the vessel intends to proceed out of the Suez Canal waiting area anchorage to a safer location for anchoring. To this Master request, port control instructed vessel to hold position as the convoy was in progress of starting and the pilot was on the way to vessel.

At 05:48 HRS / LT, the first pilot boarded the vessel by a tug. The pilot met with Chief Officer and escorted to the bridge. On the bridge, the pilot and Master conducted an exchange of information as per MPEI procedures and the pilot informed bridge that we would be position No. 3, which would be the first container vessel in convoy.

Master informed the pilot that as per previous instructions received from port control, they were supposed to following Cosco Galaxy, but the pilot said the convoy number is reshuffled and that they were now first container vessel in the convoy at position No. 3.

When approaching the buoyed channel, the port control informed the pilot in local language some information and the pilot aborted the Canal approach and started turning to port way from the entrance, on questioning what the issue is, the Pilot said the convoy sequence has changed again and they should follow Cosco Galaxy, as per original schedule. From the above, it can be concluded that Pilot was not fully updated with respect vessel sequence in the convoy.

Finally, vessel followed Cosco Galaxy at position No. 5 in the convoy, as the third container vessel.

The vessel entered the Suez Canal approach channel, without any assistance from tugs, and the first part of the transit was uneventful. The pilot provided the helmsman **courses to steer and the vessel as well controlled**. The pilots changed at about **07:20 HRS / LT** after two pilots had embarked. The pilots conducted a handover (in Arabic language) and the first pilot departed afterwards. The two new pilots remained, one was providing direct conning orders, the other was observing and monitoring. Master was also monitoring the actions of the pilot throughout and there was time for brief verbal exchange of navigation details along with the usual form.

At around the time that the pilots changed over, the wind speed increased and visibility was severely reduced with sand for couple of minutes, Master and Pilots had difficulty maintaining position in the center of the channel, in order to correct position of vessel, and place her in the center of channel conn pilot ordered additional full ahead to increase speed and assist with steering. This order was complied with and the speed was increased to 12 Knots (GPS) over the ground (48 RPM).

At this point it should be noted that apart from navigation in confined waters, the speed of 12 knots, was also a hazardous factor. The excessive speed, however, is not uncommon while transiting the Suez Canal.

After the wind had increased, the pilot was issuing more helm orders to the helmsman. These orders in majority were either for hard to port or for hard to starboard, limited midship or helm orders in between. **The pilot did not give the helmsman a course to steer, only helm orders.**

As per Master statement on at least two occasions, when the vessel was turning very quickly due to these hard over helm orders, Master intervened to order to rudder amidships to reduce the rate of the vessel turning towards one of other the canal banks.

At about **07:36 HRS / LT**, the vessel was positioned on the starboard side of the canal. At about **07:37 HRS / LT** pilot ordered correcting rudder and started to turn back to port, again using large helm order, not course orders.

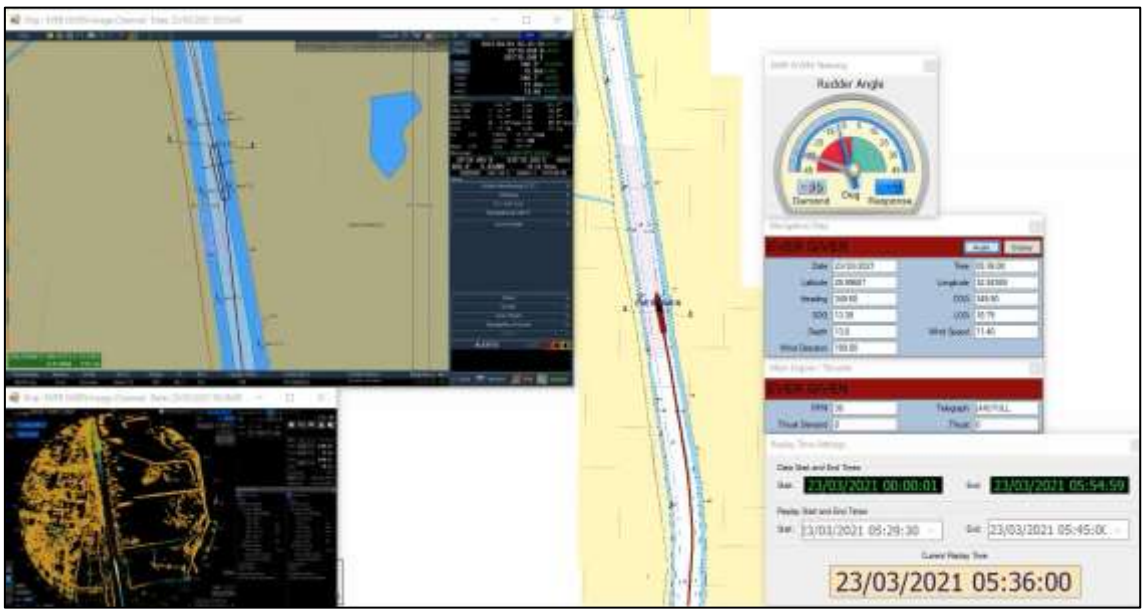


FIGURE 7: VESSEL POSSITION AT 07:36 HRS / LT
(Source: Extracted from vessel VDR)

At the same time, the first pilot reduced speed back to full ahead, about 38 RPM. After the head had started to turn to port, the pilot ordered the rudder hard to starboard, presumably to stead the vessel's head but with the reduced revolutions on the main engine, the vessel continued to turn to port. At this time, the second pilot ordered for more speed, the first pilot then also ordered maximum speed. In response, the engine revolutions were increased to navigation full ahead, 53 RPM.

From the above pilot's orders, as well as from the VDR data analysis, especially translation of discussions between the two pilots, it can be concluded that Pilots has started to realize that they could not control vessel, and that there was a risk for grounding.

Moreover, form the analysis of VDR data it was noticed that there was an argument, between the two pilots. One was insisting to provide the helmsman with course and reduce speed, and the other one continues to provide helmsman with order to hard port / stbd.

Below illustrates the discussion between the two Pilots, 8 min before vessel ran aground, all hrs are in UTC.

05:32 Hrs / UTC
- There how much 11? There
- She is 10 and …. 15
- No no … 13

05:33 Hrs / UTC
- The ship is not going right Ashraf

05:35 Hrs / UTC
- We need to reduce the speed because the distance is shortened … the distance is shortened

05:36 Hrs / UTC
- Better you give him a track Ashraf
- GIVE HIM THE CORUSE AND REDUCE THE SPEED THE DISTANCE IS SHORTENED THE DISTANCE IS 1.7
- I will sit (he means he will put the vessel in the middle of the canal) and reduce the speed
- This way you be stuck with the one in front of you

05:37 Hrs / UTC
- I increased the speed

05:39 Hrs / UTC
- (shouting) give him the track now

05:40 Hrs / UTC
- Give him the track to follow

05:40 Hrs / UTC
- Calling for help from tug MOUAN

At about **07:38 HRS / LT**, the helmsman reported that the vessel had stopped turning to port and was starting to turn to starboard. At the time, the vessel was close to the port bank of the canal and the speed had increased to about 13 knots over the ground. The vessel then started to turn quickly to starboard, away from the port bank. The pilot initially ordered the rudder to port 20 degrees and then hard to port to stop the vessel from turning. Then the second pilot started shouting at the first pilot in local language, there appeared to be a disagreement between them.

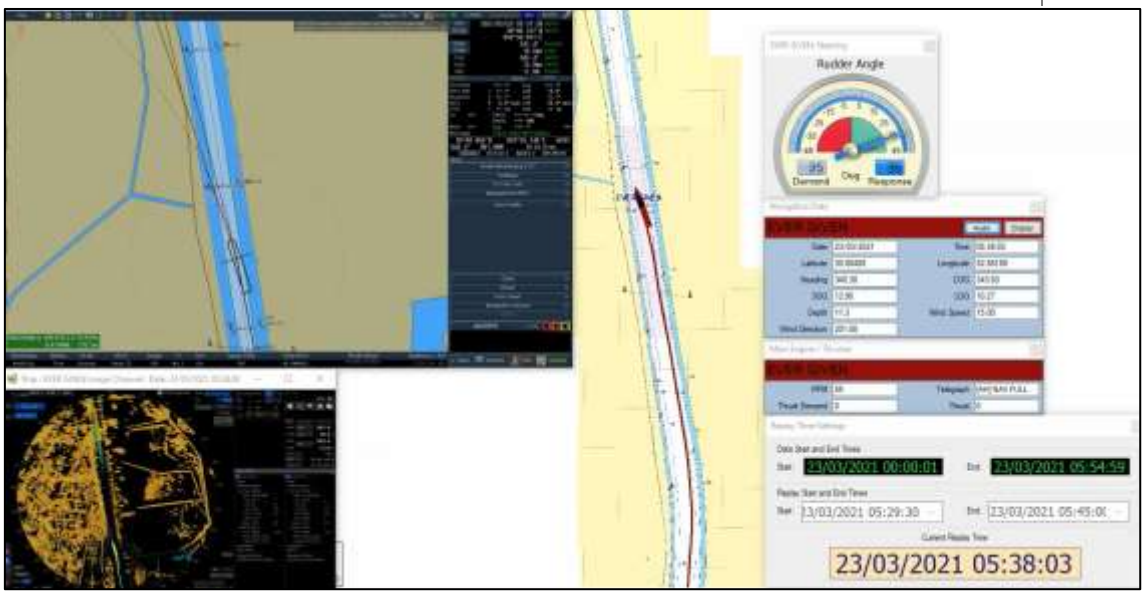


FIGURE 8: VESSEL POSSITION AT 07:38 HRS / LT
(Source: Extracted from vessel VDR)

The first pilot reduced speed to half ahead at **07:39:55 HRS / LT** and the vessel continued to turn to starboard. There was another discussion between the two pilots in local language and the main engine was increased to full ahead again. The vessel continued to turn starboard, towards the starboard canal bank. The pilot again ordered hard to port presumably to try to steady the heading but vessel continued turning to starboard side. The main engine revolutions were increased to Nav full ahead (53 RPM) but still the vessel was swinging heavily starboard. The vessel continued this swinging and grounded at a speed of about 12 knots over the ground on the eastern bank of the canal at **07:41 HRS / LT**, at location 30 01.059 N / 032 34.810E. On grounding the pilot at (**07:43 HRS / LT**) ordered Full Astern and then Crash Astern (**07:44 HRS / LT**), neither orders had any effect. Master also ordered the bow thruster to be started after the grounding, in his first effort to refloat vessel.

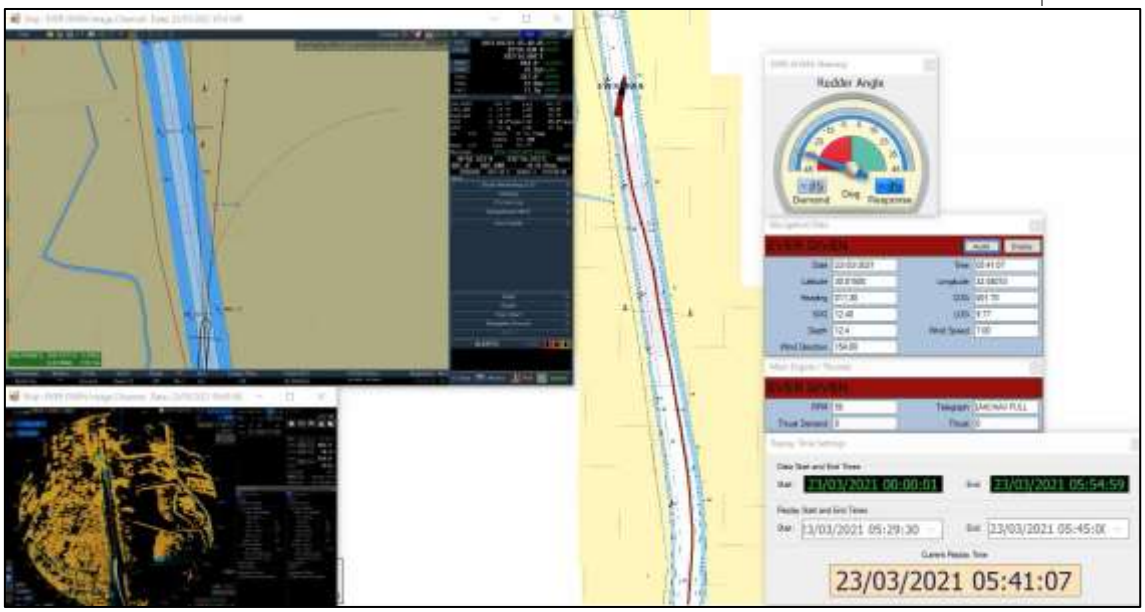


FIGURE 9: VESSEL POSSITION AT 07:41 HRS / LT – GROUNDING
(Source: Extracted from vessel VDR)

At all times throughout the transit canal, up to the time of the grounding the main engine, steering and navigation systems on board the vessel reported to function correctly, and not any kind of malefactions or error alarms were raised. This was also confirmed during the o/b physical inspection as well as from VDR data analysis.

Sequence of event – Flow diagram

23 March 2021, the vessel dropped anchor at E16 anchorage south of the Suez Canal at about **00:24 HRS / LT**

At **05:48 HRS / LT**, the first pilot boarded vessel by tug

1.The pilots changed at about **07:20 HRS / LT**

1.At around **07:20 HRS / LT** , the wind speed increased and visibility was severely reduced with sand for couple of minutes, pilots had difficulty maintaining position in the center of the channel, in order to correct position of vessel, and place her in the center of channel con pilot ordered additional full ahead to increase speed and assist with steering. This order was complied with and the speed was increased to 12 Knots (GPS) over the ground (48 RPM).

After the wind had increased, the pilot was issuing more helm orders to the helmsman. These were either for **hard to port or for hard to starboard, with few midships or lesser helm orders in between**. **The pilot did not give the helmsman a course to steer, only helm orders**

At about **07:36 HRS / LT**, the vessel was positioned on the starboard side of the canal.

1.At the same time, the first pilot reduced speed back to full ahead, about 38 RPM. After the head had started to turn to port, the pilot ordered the rudder hard to starboard, presumably to stead the vessel's head but with the reduced revolutions on the main engine, the vessel continued to turn to port. At this time, the second pilot ordered for more speed, the first pilot then also ordered maximum speed. In response, the engine revolutions were increased to navigation full ahead, 53 RPM

1.At about 07:38 HRS the helmsman reported that the vessel had stopped turning to port and was starting to turn to starboard. At the time, the vessel was close to the port bank of the canal and the speed had increased to about 13 knots over the ground. The vessel then started to turn quickly to starboard, away from the port bank. The pilot initially ordered the rudder to port 20 degrees and then hard to port to stop the vessel from turning. Then the second pilot started shouting at the first pilot in local language,

The pilot again ordered hard to port presumably to try to steady the heading but vessel continued turning to starboard side. The main engine revolutions were increased to Nav full ahead (53 RPM) but still the vessel was swinging heavily starboard. The vessel continued this swinging and grounded at a speed of about 12 knots over the ground on the eastern bank of the canal at **07:41 HRS / LT**, at location 30 01.059 N / 032 34.810E.

5.2 Salvage and Refloating:

After vessel run aground, Master tried to refloat her, by using vessel bow thruster, it was quickly understood that this was not possible, therefor assistance from SCA requested. Initially, SCA tried to refloat her, using canal tugs, initial attempts to dislodge the ship included using a digger to excavate the bow while tugboats worked to pull and push the vessel free, however canal tugs did not have sufficient HP to push and release **M/V EVER GIVEN**.

On **29 March 2021**, the stern of **M/V EVER GIVEN** was refloated at **04:30 HRS / LT** and on **15:05 HRS / LT** local time the ship was pulled free, and was towed to the Great Bitter Lake for inspection.

FIGURE 10: M/V EVER GIVEN PULLED FREE
(Source: Photos taken during physical attendance o/b)

5.3 Damages due to Grounding:

Subject vessel was attended, by ABS Class surveyor on **31 March 2021** at Bitter Lake of Ismailia to examine and report on vessel's grounding and the following were reported:

Vessel's bow, transom and side shell plating were visually examined above the water line and no signs of structural damage or deformation were found. The drafts marks at this time were noted to be:

Forward (Ps & STBD): 15.2 M
Amid ship: (PS): 15 M & (STBD) 14.6 M
Aft: (PS): 15.6 M & (STBD) 15.4 M

- It was verified from E/R logbook that Machinery and Steering Gear are operating normally subsequent to the vessel's grounding on the 23rd March, and with no vibrations and/or abnormalities noted.

- Engine Room was internally examined as far as could be seen with no observed damage in way of bottom and side shell plates.
- Main Engine Foundation was visually examined and found in satisfactorily condition. Operational testing of Steering gear was carried out satisfactorily.
- Engine room sea suction filters were opened out and cleaned.
- Main Engine Crank Shaft deflections were carried out and same verified to be in accordance with maker's allowable limit.
- Records of periodical sounding of bilge and bottom tanks were verified and found satisfactory with no water ingress.
- C/H No. 01 was internally examined as far as could be seen with no observed damage.
- Bilge suction inside C/H No. 01 was satisfactorily operationally tested.
- Emergency Fire Pump considered damage and out of service due it being located within the bow thruster room which is fully flooded. As a Mitigation measure, two (2) portable submerged fire pumps were provided onboard and connected to the Emergency switch board, and same were operationally tested with fire hoses and considered satisfactory for the interim period until permanent repairs to the emergency fire pump can be carried out. Emergency Generator was operationally tested and considered satisfactory at this time. Main Fire Pump was operationally tested and considered satisfactory at this time. Other fire extinguishers onboard were verified in satisfactory condition at this time.
- NO.1 WBT (C) "adjacent to Bow Thruster room" was internally examined and found intact with no observed damage.
- An internal inspection of WB DB tanks (3 PS & 3 STBD) was carried out and the aforesaid tanks found intact with no observed damage or structural deformation of internals.
- An internal inspection of DB-WBT (4 PS & 4 STBD) was carried out the aforesaid tanks found intact with no observed damage or structural deformation of internals.
- An internal examination of duct keel "entire length" was carried out and the duct keel found intact with no observed damage or structural deformation of internals.
- Double bottom water ballast tank No. 2S was internally examined & the following minor damage were found:
    - 1st vertical stiffener (from inner longitudinal watertight bulkhead) attached to transverse bulkhead at Frame. No. 116 found slightly buckled in connection with 1st bottom longitudinal (from inner longitudinal watertight bulkhead).
    - 1st vertical stiffener & 1st bottom longitudinal (from inner longitudinal watertight bulkhead) attached to transverse bulkhead at Frame. No. 117 found slightly buckled.
    - Bottom shell plating found slightly deformed between frames Nos. 117 to 118 (Longitudinally between longitudinal watertight bulkhead to 2nd bottom longitudinal) by approximately 15cm set-in.
    - 8th bottom longitudinal (from starboard side shell plating) with its associated bracket at frame No. 116 found slightly deformed.
    - Vertical stiffener attached to bulkhead No. 116 found slightly buckled in connection with 3rd bottom longitudinal from starboard shell plating.
    - 3rd & 4th bottom longitudinal (from starboard side shell plating) at frame No. 115 found slightly deformed with their associated brackets. -

7th bottom longitudinal (from starboard side shell plating) at frame No. 117 found slightly deformed.

- Double bottom water ballast tank No. 2P was internally examined & the following minor damage were found:
  - 2nd vertical stiffener (from inner longitudinal watertight bulkhead) attached to bulkhead at frame No. 117 found slightly buckled in connection with 2nd bottom longitudinal.
  - 3rd vertical stiffener & 3rd bottom longitudinal (from inner longitudinal watertight bulkhead) attached to bulkhead at frame No. 117 found slightly deformed.
- During re-floating operations of the vessel and prior to ABS attendance, SMIT Salvage Team did the following actions and same will remain during vessel sailing as advised by owner: -
  - Cut off vent pipes of Thruster Room & vent pipes of F.P Void space and blanked-off with air pipe connection to supply compressed air into thruster room and FP void space to control the water level inside these flooded compartments if need it.
  - Closed- out the openings in way of non-WT bulkhead at Fr# 127 from above Bow Thruster Room till 2nd deck.
- Upper freeboard deck was visually examined as far as could be seen including the hatch coamings & corner attachments to the deck and same found with no observed damage, distortion, or fracture.
- 2nd deck was examined through the passage way (PS & STBD) with no observed damage or distortion.
- Underwater examination for the entire vessel was carried out on 02 April 2021 by an ABS approved In-Water Survey Firm (Suez Canal Authority) in presence of ABS surveyors and the following damage noted
- Bow Thruster Room and F.P Void Space flooded.
- Damage area found located between Fr# 129 to Fr # 157 from base line up-to Thruster Tunnel. This damage area was found with several fractures, openings, sharp deformations with irregular shapes and irregular dents (PS & STBD), width of damage area approximate 10 m The bottom plates found set-in between Fr 129 – 157 with width 10 m and depth 2.5 m.
- The following fractures / openings were found in way of bottom and side shell plates as following
  - Fracture at frame No. 155 with the following dimensions (60*22 cm) at C.L.
  - Fracture at frame No. 153 with the following dimensions (55*22 cm) at PS.
  - Fracture at frame No. 150 with the following dimensions (125*10 cm) at PS.
  - Fracture at frame No. 147 with the following dimensions (160*10cm) at PS.
  - Fracture between frames Nos. 131 to 137 with 1200 cm length and 10 cm width at Port Side.
  - Fracture at frame No. 131 (Bow thruster room) with the following dimensions (40*15 cm) – PS.
  - Fracture at frame No. 131 (Bow thruster room) with the following dimensions (60*15 cm) – STBD.

- The rudder was visually examined, and no damage was observed at this time. In addition, the rudder was put at midships and the rudder angle indicator was verified at Zero in the wheelhouse and Zero at Steering Gear Compartment, and at the same time the divers confirmed that the rudder is lying at midships with no physical deviation.
- Low and High sea chests were found clear from sand or mud.
- Bow Thruster Tunnels were found full of Mud.
- Speed Log and Echo Sounder found damaged and are considered "Out of Order "because of grounding. However, the speed over the ground can be obtained from GPS / no temporary measure for echo sounder. Two (02) DGPS were verified in satisfactory condition at this time. Manual input of the speed should be made by the crew accordingly.
- Bottom plates scratches and Side Shell plates scratches were found in several location between Fr# 105 to Fr# 160 (STBD) & between Fr# 125 to Fr#160 (PS)
- The propeller was found in satisfactory condition with only the following minor damages
    - Blade # 1: minor cut in way of blade tip "12 cm x 1.5 cm" & scratches over an area 1m x 0.5m x 0.5 mm depth - Blade # 2: scratches over an area 1m x 0.1m x 0.5 mm depth
    - Blade # 3: minor cut in way of blade tip "15 cm x 0.5 cm"
    - Blade # 4: scratches over an area 1.5m x 0.4m x 0.5 mm depth

The owners advised their intention to sail for one single voyage from Bitter lakes to Suez Anchorage Area or Port Said anchorage area in present loaded condition and under her own power / propulsion for a reevaluation and carrying out temporary repair as deemed necessary prior to the vessel transiting from Port Said to Rotterdam.

5.4 Fatigue Parameter:

According to the definition given by the IMO, Fatigue is a state of feeling tired, weary, or sleepy that results from prolonged mental or physical work, extended periods of anxiety, exposure to harsh environments, or loss of sleep. The effects of fatigue are impaired performance and diminished alertness.

Moreover, as per relevant regulations / codes (STCW / MLC / ILO), the "shipowner" must guarantee that crewmembers stick to maximum working hours or minimum resting time:

- The maximum working hours must not exceed 14 hours in any 24-hour period and 72 hours in any 7-day period
- The minimum resting time cannot be less than 10 hours in any 24-hour period and 77 hours in any 7-day period
- You can divide the hours of rest into a maximum of two parts. If you split the rest, one of the two rest periods must last at least 6 hours and the interval between consecutive rests periods cannot exceed 14 hours.

It should be also highlighted that fatigue is not equal to sleepiness, primary through a lack of sleep, but instead there are two different types of fatigue, that both are of equal importance:

- **Physical fatigue** when a person finds it physically hard to do the things they normally do or used to do; it includes muscle weakness and diagnosis may involve a strength test.
- **Mental fatigue** when a person finds it harder to concentrate on things and stay on task. The person may feel sleepy, or have difficulty staying awake while working.

Based on the above it can be concluded that "fatigue" parameter is of vital importance in order to ensure / undertake a safe voyage or passage. Therefore, the possibility of presence of fatigue (Physical / Mental) of the crew on duty on board **M/V EVER GIVEN**, has been investigated as far as possible.

In particular following aspects were examined, for all crewmembers which were on duty at the time of the incident.

1. Records of Hours of work and Hours of rest.
2. Seafarer Employment Agreements.
3. Crew recreation areas.
4. Provision area (particular attentions were given to cleanness / quality / quantity).

In addition, the above, interviews conducted with all "incident involved" crew members, in order verify fatigue evidences.

According to the records provided, physical inspection (Bridge, E/R, Crew accommodation) and interviews conducted, crew involved in the casualty **was rested** adequately, working and leaving condition found satisfactory, and no any evidence of physical or mental fatigue was observed.

Therefore, **fatigue parameter cannot be considered as a contributing factor**.

5.5 Drug & Alcohol:

"Bernhard Schulte Shipmanagement (Hong Kong) Limited Partnership" implements a drug and alcohol policy in line with relative regulations and best maritime practices.

In particular the company policy is divided into following two categories of vessels.

- Tanker / LNG/LPG – sale and consumption of any kind of alcohol is strictly prohibited.
- Non-Tankers – consumption of alcohol is limited to beer only with a alcohol content of less than 6%.
- Tanker & Non- Tankers – any form of drug with the exception of prescribed and acceptable over the counter drugs, are totally banned from company managed vessel.

As far as regarding Non-Tankers vessels, alcohol policy includes following conditions:

- 1 hour of abstinence from duty for each unit of alcohol consumed;

- Total abstinence from alcohol for 4 hrs prior to a period of scheduled responsibility, i.e watch keeping duties, port arrival / departure etc. and performing designated safety, security and marine environmental duties;

The control measures and screening program of drug & alcohol company policy found to be properly implemented and followed o/b.

In particular records examined and found that company maintains the system based on breathalyzers with periodic, random and post incident testing to monitor the effectiveness of this Policy. This includes pre-joining D&A Test (Medical records), Monthly unannounced on-board alcohol tests, Annual unannounced drug and alcohol tests (by contracting laboratory) for all crew members and breathe test of all crew returning from shore.

Moreover, Master is authorized to test any member in case of suspicion of alcohol consumption, the Chief Officer and Chief Engineer shall carry out the testing.

All Bridge Team crew members have undertaken a drug/alcohol test, immediately after the incident, from Master and from Suez Canal Authorities with negative results.

In view of the above the influence of alcohol consumption is unlikely to be a contributing factor towards the grounding of **M/V EVER GIVEN**.

6.0 Analysis:

6.1 VDR Analysis:

6.1.1 Introduction:

Voyage Data recorder analysis or commonly known as **VDR** analysis plays an important role for shipping companies' performances. It has become an integral part of voyage analysis to be done for continuous improvement & training purposes. **VDR** is meant to save the recent data of vessel's navigational movements via recording each and every moment, voice and equipment data.

6.1.2 VDR Specifications:

Maker	**Japan Radio Co.**
Model	**JCY - 1900 / S.N.:MB52703**
Retrieved Data Duration	**05Hours 55 MIN from 00: 00 UTC to 05:55 UTC**
Installation Compliance	*VDR system as installed follows MSC Circular 163 (78), IMO Resolution MSC 333(90).*
VDR analysis standards / guidelines	*The present VDR analysis report is in line with guidelines provided in* 1. *ICS Bridge Procedures Guide (International Chamber of shipping)* 2. *TMSA (OCIMF)* 3. *OCIMF-SIRE VIQ 7* 4. *OCIMF-A Guide to best Practice for Navigational Assessments and audits* 5. *OCIMF- Recommendations on usage of ECDIS and Preventing Incidents* 6. *OCIMF recommendations on the proactive use of Voyage Date* 7. *INTERTANKO Guide to safe Navigation (including ECDIS)*

6.1.3 Description of the Event:

Based on **VDR** data that have been received, Panama Flag container ship **M/V EVER GIVEN,** on Tuesday, **March 22, at 22:30 LT**, arrived at Suez Port. The vessel has been anchored to conduct the inspection by Suez Canal Authorities, prior passing the Suez Canal. On **March 23, at 07:16 HRS / LT**, two (2) Canal Pilots boarded the ship, and commenced the transit of the Suez Canal.

Below is a tabulated summary of the time frame of **VDR** data analysed from **23 March 2021 @ 00:00:00 UTC to 23 March 2021 @ 05:55:30 UTC**, all "times" are based on **VDR DATA** which have been recorded in **VDR display time.**

EVENT	DATE	TIME (UTC	LAT. (N)	LONG. (E)	Depth (m)	Heading (°)	Rudder Order (°)	Eng. Tel.	STW (Kts)	Rel, Wind Dir. (°)	Wind Speed m/s
Proceeding to enter the Suez Canal	23/03/2021	0506	29°55.0370'	032°32.9156'	10.8	26.7	P5.3	FULL	7.0	077	4.4
Entering Suez Canal	23/03/2021	0511	29°55.5889'	032°33.3513'	12.5	049.1	P20	FULL	6.9	100	9.8
Transiting Suez Canal	23/03/2021	0513	29°55.7903'	032°33.5955'	12.5	051.0	P34.7	FULL	6.8	79	10.1
Transiting Suez Canal	23/03/2021	0517	29°56.2062'	032°34.0710'	12.0	047.8	P29.7	FULL	6.6	84	7.0
Transiting Suez Canal	23/03/2021	0522	29°56.8746'	032°34.7164'	11.7	33.7	P34.1	NAV FULL	6.1	126	8.3
Transiting Suez Canal	23/03/2021	0525	29°57.4250'	032°35.0279'	11.5	15.1	S35.5	NAV FULL	10.4	155	12.1
Transiting Suez Canal	23/03/2021	0530	29°58.5136'	032°35.2156'	11.6	003.4	P19.8	NAV FULL	11.1	167	9.0
Transiting Suez Canal	23/03/2021	0534	29°59.4304'	032°35.1045'	13.1	348.7	P0.2	NAV FULL	10.7	204	13.5
Transiting Suez Canal	23/03/2021	0537	30°00.0654'	032°34.9686'	11.0	343.3	S35.0	FULL	10.5	210	13.9
Transiting Suez Canal	23/03/2021	0540	30°00.7066'	032°34.8106'	12.5	357.8	P34.9	FULL	10.6	181	12.0
Grounding	**23/03/2021**	**0541**	**30°00.9913'**	**032°34.8188'**	**2.5**	**016.3**	**P35.3**	**NAV FULL**	**10.1**	**152**	**12.0**

TABLE 7: TIME FRAME OF VDR DATA ANALYSED
(Source: Extracted from VDR data)

6.1.7 Key Events – Time Line:

EVENTS BOOK ENTRIES – Date: 22/03/2021 to 23/03/2021	
TIME (LT)	EVENT
22/03/2021 22:15	Conn with master
23/03/2021 03:05	Notice to e/r due to strong winds
03:18	M/E Control on Bridge
03:54	Port Anchor Aweigh sighted and cleared
04:10	Gust of wind (wind speed 13.9 m/s)
05:48	Pilot On Board, Master Pilot Info Exchange Completed
07:16	Two (2) Canal POB
07:18	Electrician Onboard
07:20	Pilot Away. MPIE (Master Pilot Info Exchange) done
07:41	**Vessel AGROUND**

TABLE 8: KEY EVENTS – TIME LINE
(Source: Extracted from VDR data)

6.1.4 Radar List & Initial Settings:

RADAR	R1	R2
Type	**S BAND**	**X BAND**
Range	**0.75 nm**	**1.5 nm**
Display	Off centre N up	Off centre N up
Vector	AIS	AIS
CPA	0.1 nm	0.1 nm
TCPA	1 min	1 min
Past Position	AIS	AIS
Trails	3 min T	3 min T
Gain	Manual	Manual
Clutter	Manual	Manual
TGT Disp	AIS	ARPA
Radar Map	No	No

TABLE 9: RADAR LIST / INITIAL SETTINGS
(Source: Extracted from VDR data)

6.1.5 ECDIS List & Initial Settings:

	ECDIS 1	ECDIS 2
SCALE	1/7500	1/10000
RADAR	OFF	OFF
DISPLAY	NORTH UP TM	NORTH UP TM
STABILIZED	GROUND	GROUND
VECTOR	6 MIN	8 MIN
MOTION	TRUE	***
AIS / TT FILT	AIS / OFF	AIS / N°2
FEED	GPS 2	GPS 2
WGS	84	84

TABLE 10: ECDIS LIST & INITIAL SETTINGS
(Source: Extracted from VDR data)

All above documentation reviewed and found in compliance with company SMS procedures. While reviewing the passage plan for the current voyage with the Bridge Log book and VDR data it has been noted that the times recorded are as follows:

6.1.6 Navigation Phases:

Below listed navigation phases examined / compared with vessel's passage plan "**MOM 054 Rev 9**" and found satisfactory.

6.1.7 Position Fixing Frequency:

Vessel's position has been fixed in frequent intervals and ensured that the planned track was maintained as confirmed from vessel's passage plan "**MOM 54 Rev9**", and found satisfactory.

6.1.8 ARPA / CPA:

While analysing the VDR Data and while the vessel was transiting the Suez Canal, both Radars (X, S Band) were in good use, without any reported alarms of defects. Additionally, from service reports and from ECDIS play back, good operation was verified.

6.1.9 UKC:

SMS forms provided **(MOM Rev 9)** reviewed and it was noted that bridge team members were familiar with company specific requirements relating to UKC when in open waters, confined waters, channels and fairways and when alongside.

6.1.10 Communication:

During the period of analyzing the VDR Data the VHF communication was properly maintained, and the VHF was properly operated.

6.1.11 Echo Sounder

While reviewing VDR Data, and vessels passage plan, vessel's echo sounder during the transiting of Suez Canal, was operated normally, without any error alarms.

6.1.12 Bridge Alarm Status:

Vessel's bridge alarm status reviewed and found that during the period of analysing the VDR Data **there were no any error alarms.**

FIGURE 11: Alarm Status - (Source: Extracted from VDR data / Alarm Status)

Note: Bilge alarm was noted at 07:45:54 HR LT, 4 minutes after the grounding, due to the water ingress in the bilge flowing aft (change in trim).

6.1.13 Rudder Angle:

Using / analysing the data of "course-heading recorded" in **VDR**, it can be concluded that vessel rudder angle indicator was properly responded, without any operational defects and without any error alarms.

Note: Steering gear overload alarms (three in total) observed at between 07:44:08 HR LT and 07:45:39 HR LT, due to external force on the ruder.

6.1.14 VDR Mics:

VDR mics found to work properly for the time interval analysed.

6.1.15 Wind Speed:

Vessel's wind speed and direction indicator were properly connected on VDR, without any error alarms.

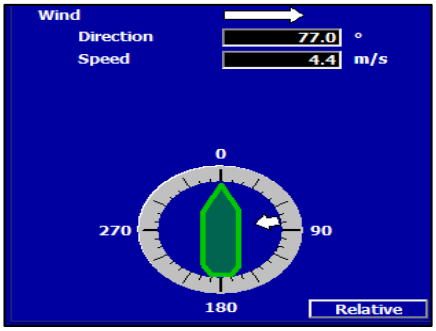


FIGURE 12: Wind Indicator - (Source: Extracted from VDR data)

6.1.16 Bridge Team Interaction / Delegation:

Interaction of bridge team members found satisfactory. From the audio analysis of **VDR** it was noted that bridge team was busy with navigation, without any evidences of neither being over pressurized, nor complacent either.

Moreover, from the audio records, it was observed that Bridge team members had a good understanding of their responsibilities and demonstrate confidence in their execution.

Good communication / cooperation between Pilot and helmsman, observed.

During Suez Canal, transit navigation/maneuvering orders & instructions were given to the helmsman from Pilots and the captain make interventions when He think it was necessary, but none of these orders was effective to prevent the grounding.

6.1.18 ECDIS:

While analysing the VDR Data and while the vessel was transiting the Suez Canal, both ECDIS (1 & 2) were in good use, without any error of defects alarms.

6.1.19 VDR Screen Shots Analysis:

The next section contains print screens and extracts from vessel VDR, used for the analysis of the sequence of events as well as for the analysis of operations and condition of navigational equipment of the marine accident.

Date/Time: 23.03.2021/05:06 UTC
Event: Start proceeding to enter the Suez Canal

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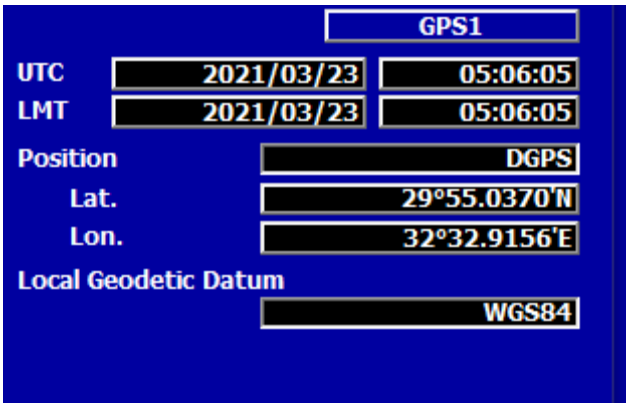
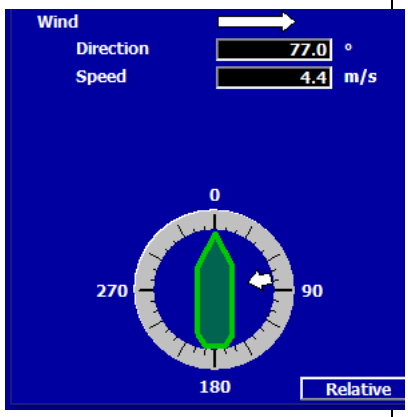
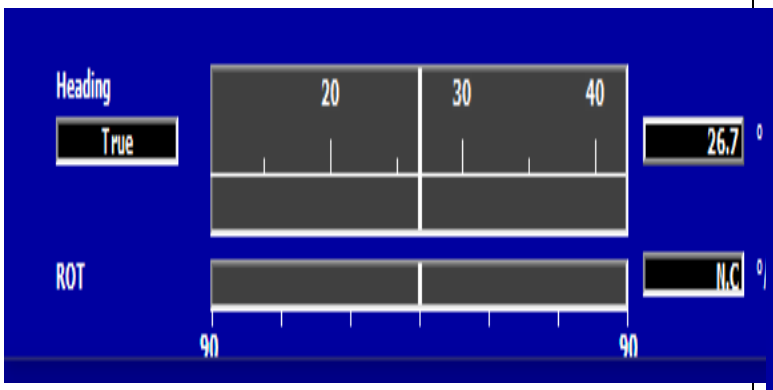
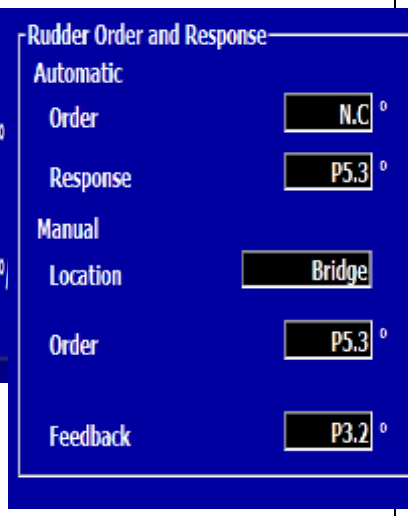
<tr><td> 
</td><td> 
</td></tr>
<tr><th>Heading/ROT</th><th>Rudder Order and Response</th></tr>
<tr><td> 
</td><td> 
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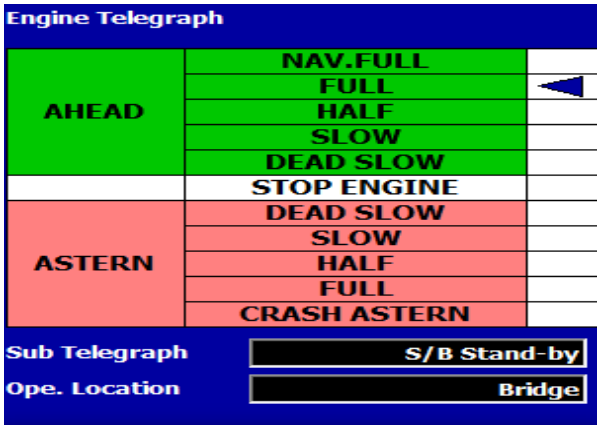
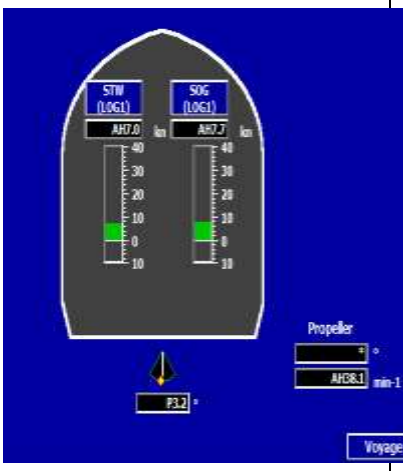
Engine Telegraph	STW/SOG
	

ECDIS 1

ECDIS 2 Depth:

Date/Time: 23.03.2021/05:11 UTC
Event: Entering the Suez Canal

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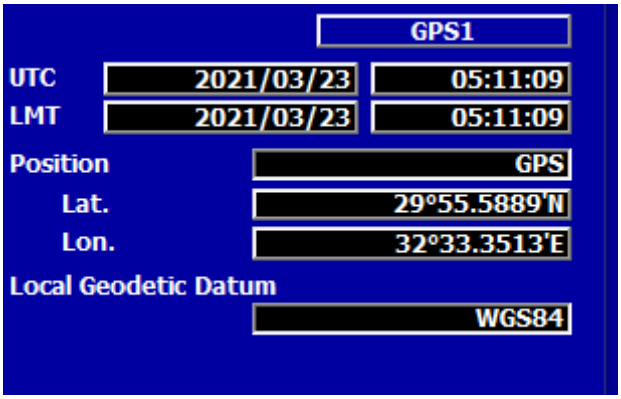
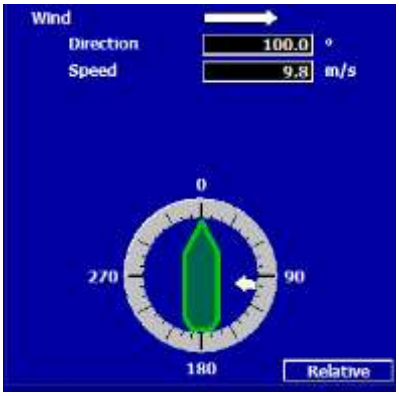
<tr><td> 
</td><td> 
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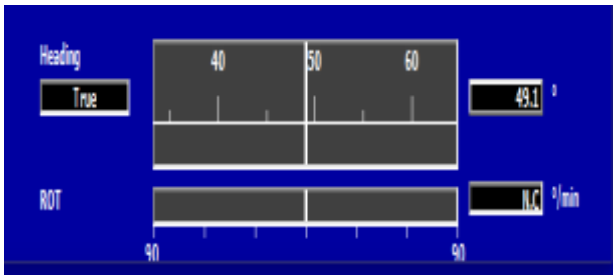
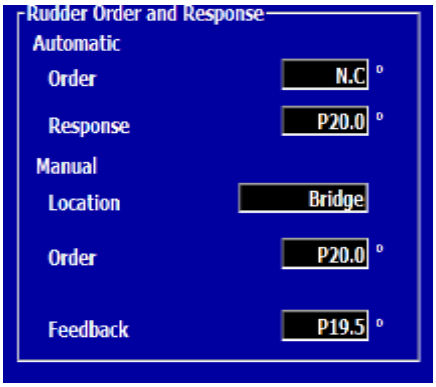
<tr><th>Heading/ROT</th><th>Rudder Order and Response</th></tr>
<tr><td> 
</td><td> 
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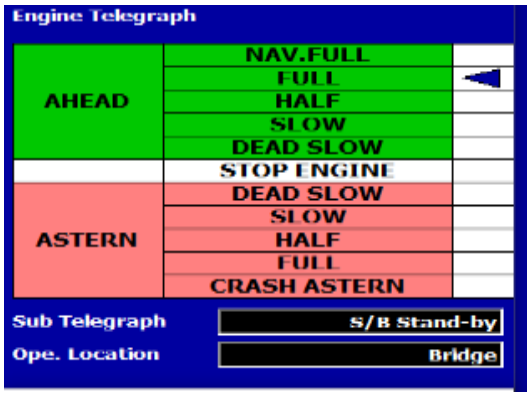
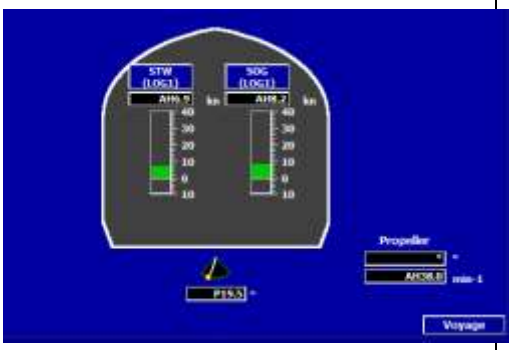
<tr><td> 
</td><td> 
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ECDIS 1

ECDIS 2

Analysis from: 05:06 hrs UTC, to 05:11 hrs UTC Navigation: • Recording started at 00:00:00 UTC • All data available from 00:00:00 UTC onwards. • At 0511 hrs (UTC) entering Suez Canal

Key Issues	No any alarm
Important Events in this Leg	None
Relat. Wind Direction/Speed	**100°/9.8 m/s**
Speed (STW)	**6.9 kts**
Depth	**12.5 m**
Heading	**049.1°**

Date/Time: 23.03.2021/05:13 UTC
Event: Transiting Suez Canal

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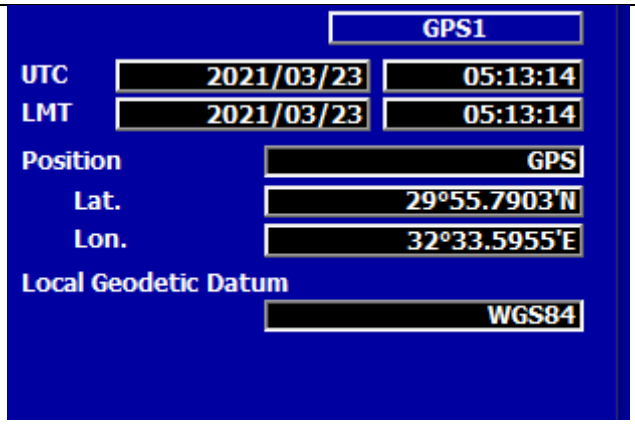
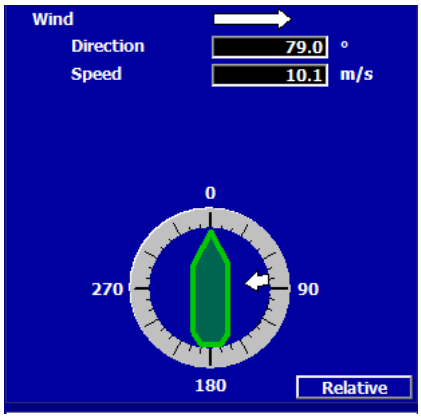
<tr><td> 
</td><td> 
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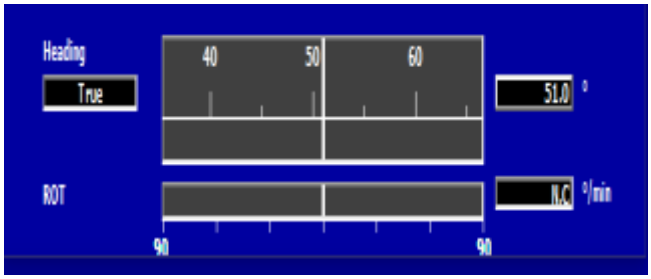
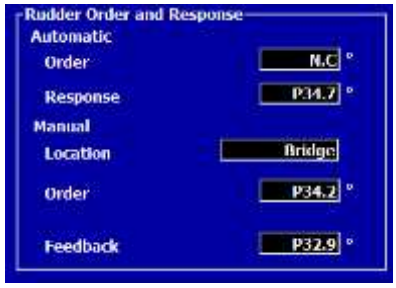
<tr><th>Heading/ROT</th><th>Rudder Order and Response</th></tr>
<tr><td> 
</td><td> 
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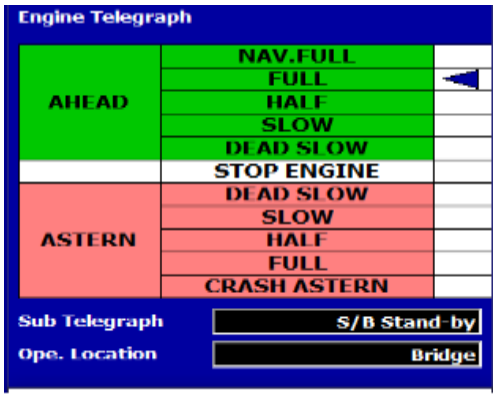
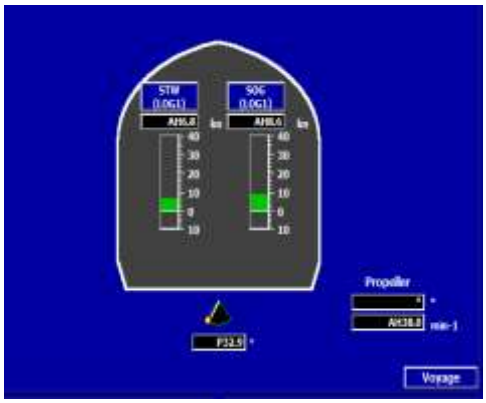
<tr><td> 
</td><td> 
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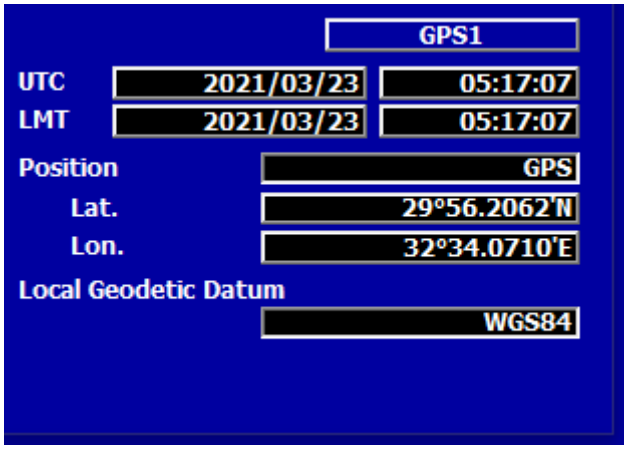
ECDIS 1

ECDIS 2

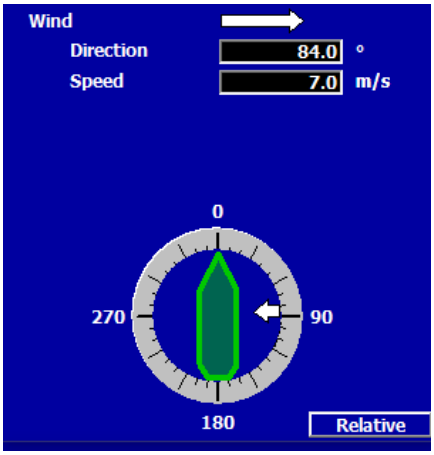

Date/Time: 23.03.2021/05:17 UTC
Event: Entering the Suez Canal

CONNING

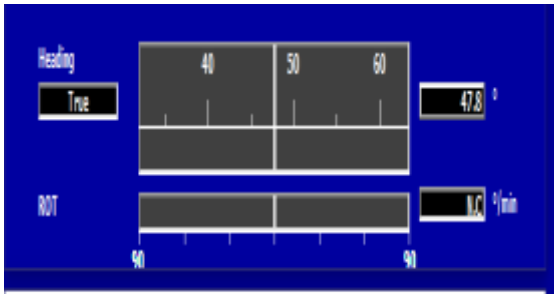
Position and Time



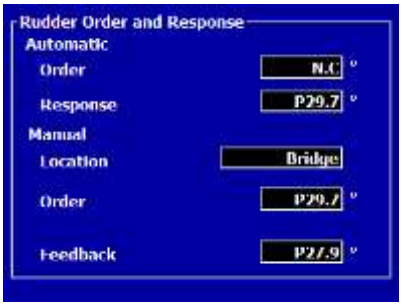
Wind Speed and Direction



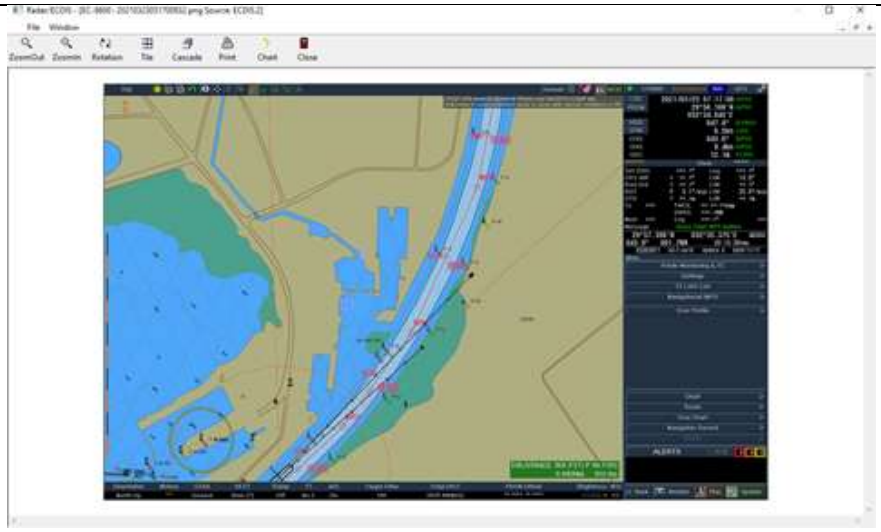
Heading/ROT



Rudder Order and Response



ECDIS 1

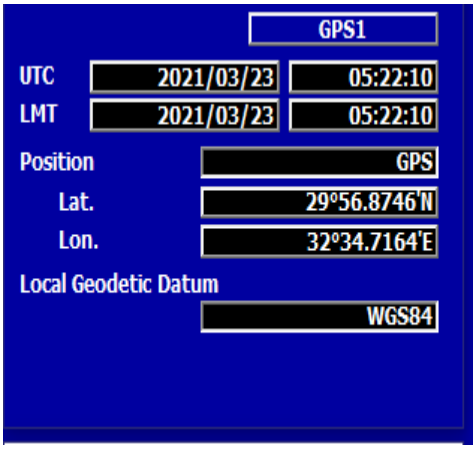
ECDIS 2

Analysis from: 05:13 hrs UTC-23/03, to 05:17 hrs UTC-23/03 **Navigation:** Recording started at 00:00: UTC All data available from 00:00:00 UTC onwards At 0511 hrs (UTC) entering Suez Canal
Important Event
   The loss of steering control likely started in this moment due to the Bank Effect The South wind pushing the vessel towards the portside bank of the canal.

Key Issues	No any alarm
Relat. Wind Direction/Speed	084°/7.0 m/s
Speed (STW)	6.6 kts
Depth	12 m
Heading	047°8

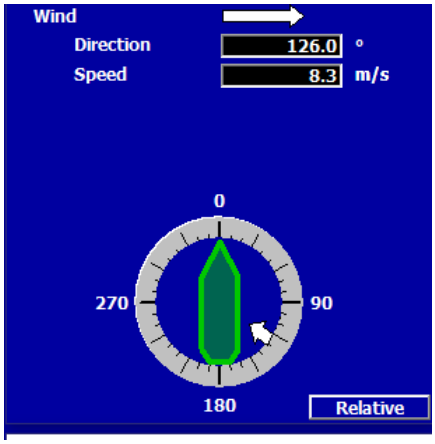
Date/Time: 23.03.2021/05:22 UTC
Event: Transiting Suez Canal

CONNING

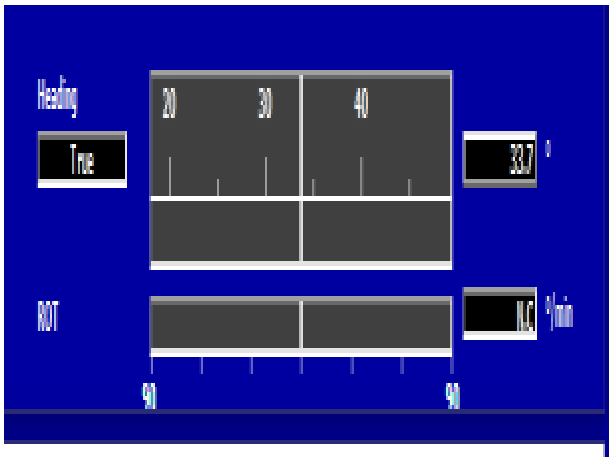
Position and Time



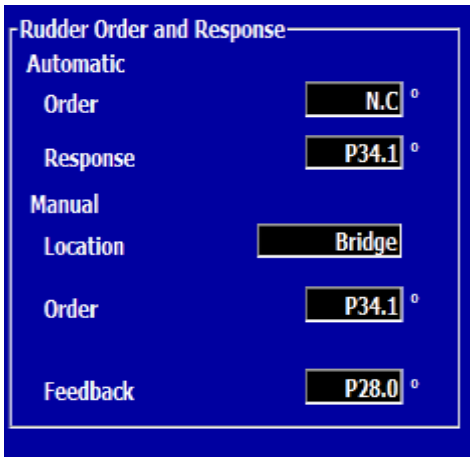
Wind Speed and Direction



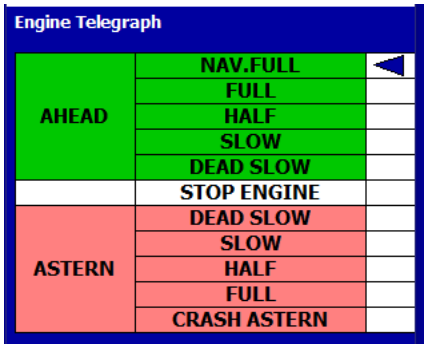
Heading/ROT



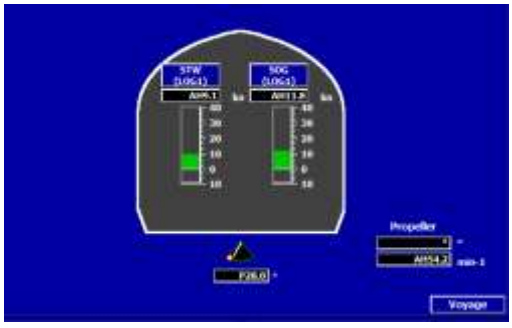
Rudder Order and Response



Engine Telegraph



STW/SOG



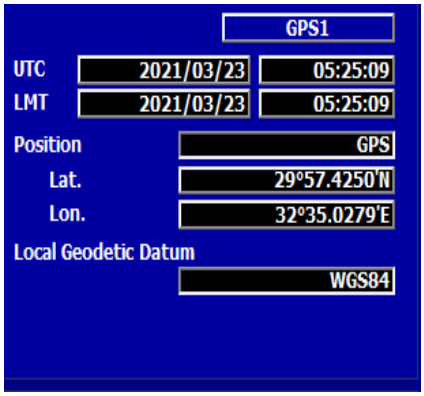
ECDIS 1

ECDIS 2

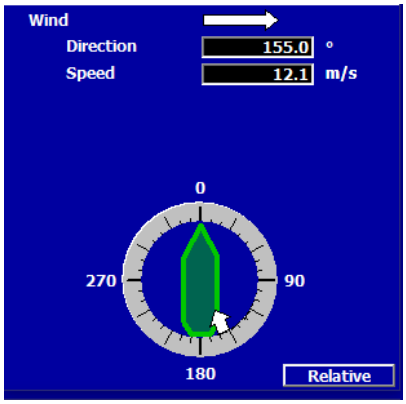

Date/Time: 23.03.2021/05:22 UTC
Event: Transiting Suez Canal

CONNING

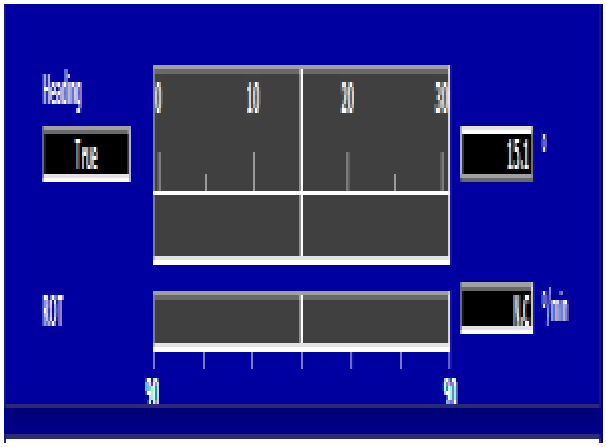
Position and Time



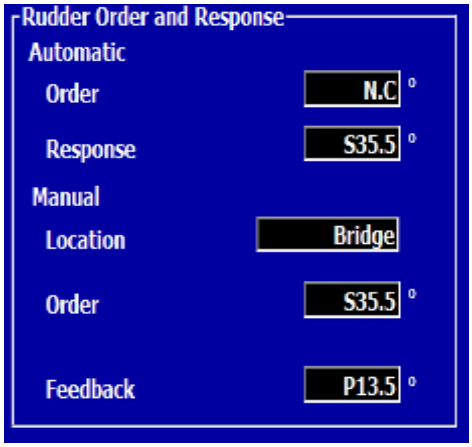
Wind Speed and Direction



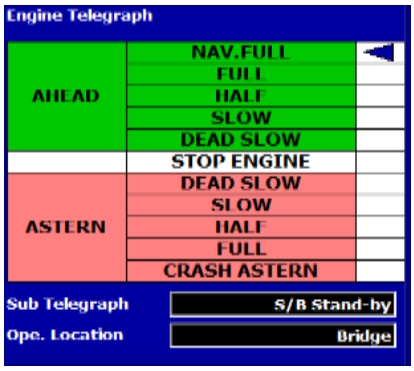
Heading/ROT



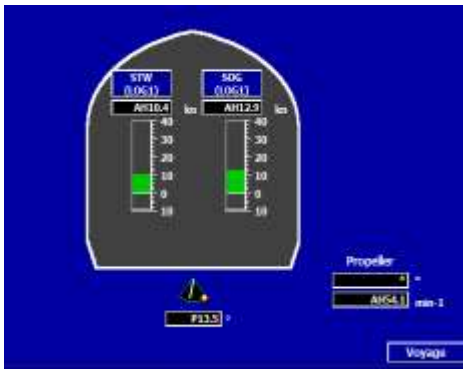
Rudder Order and Response



Engine Telegraph



STW/SOG



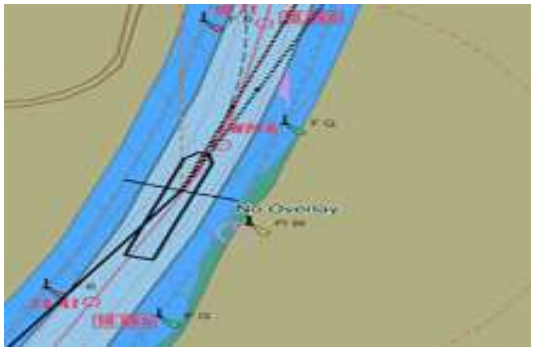
ECDIS 1

ECDIS 2

Analysis from: 05:22 hrs UTC, to 05:25 hrs UTC
Navigation:

- Recording started at 00:00:00 UTC
- All data available from 00:00:00 UTC onwards.
- At 0511 hrs (UTC) entering Suez Canal

Important Event



The **swinging** between starboard side and portside banks of the canal already started.

Key Issues	No any alarm Extreme Steering angles
Relat. Wind Direction/Speed	**155°/12.1 m/s**
Speed (STW)	**10.4 kts**
Depth	**11.5 m**
Heading	**015.1°**

Date/Time: 23.03.2021/05:30 UTC
Event: Transiting Suez Canal

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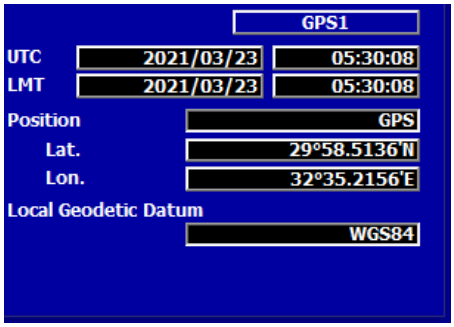
<tr><td> 
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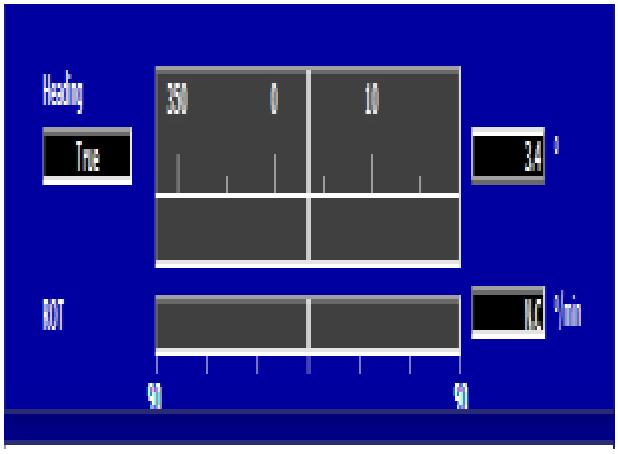
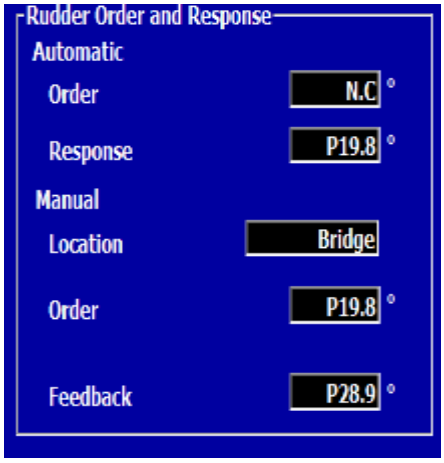
<tr><td> 
</td><td> 
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<tr><th>Engine Telegraph</th><th>STW/SOG</th></tr>
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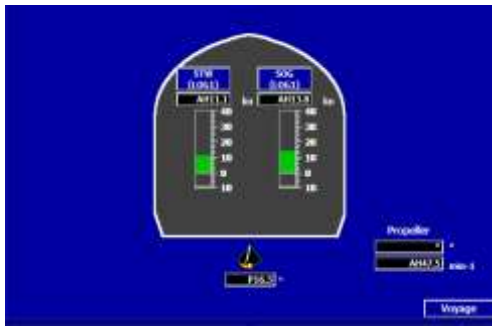
</td><td> 
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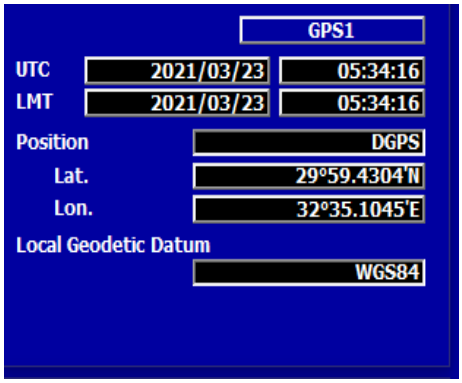
ECDIS 1

ECDIS 2

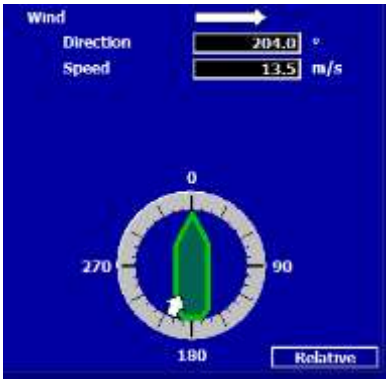

Date/Time: 23.03.2021/05:34 UTC
Event: Transiting Suez Canal

CONNING

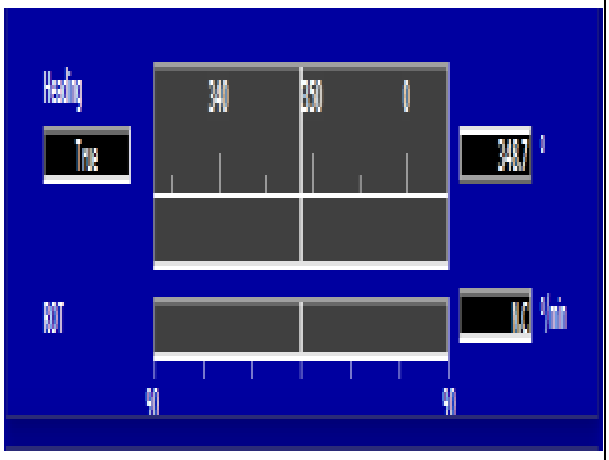
Position and Time



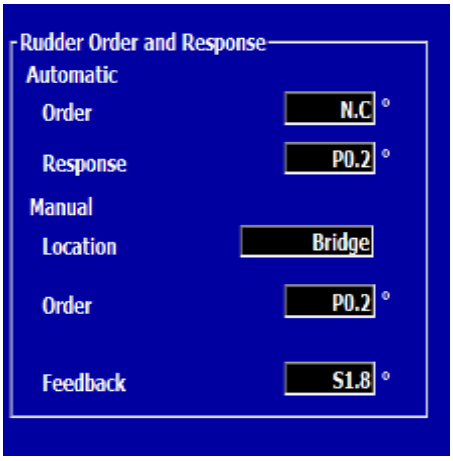
Wind Speed and Direction



Heading/ROT

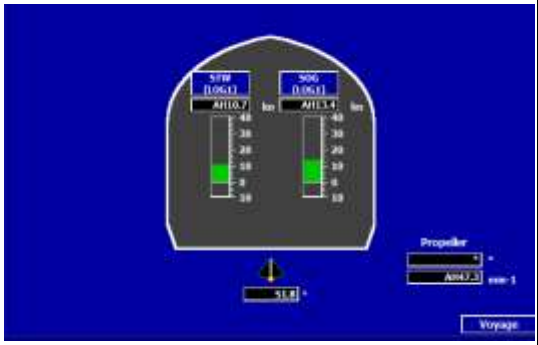


Rudder Order and Response

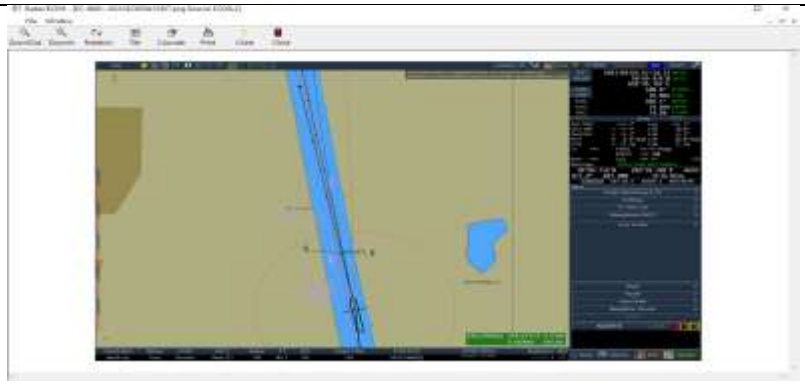


Engine Telegraph

STW/SOG



ECDIS 1

ECDIS 2

Analysis from: 05:30 hrs UTC, to 05:34 hrs UTC Navigation: • Recording started at 00:00:00 UTC • All data available from 00:00:00 UTC onwards. • At 0511 hrs (UTC) entering Suez Canal

Key Issues	No any alarm
Important Event	None
Relat. Wind Direction/Speed	**204°/13.5 m/s**
Speed (STW)	**10.7 kts**
Depth	**13.1 m**
Heading	**348.7°**

Date/Time: 23.03.2021/05:37 UTC
Event: Transiting Suez Canal

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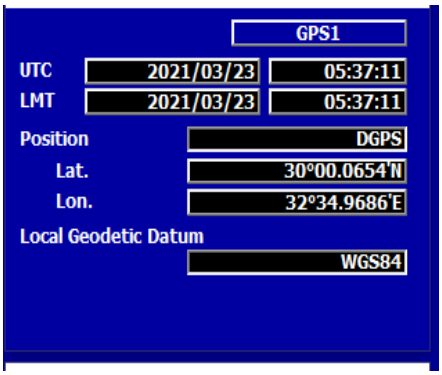
<tr><td> 
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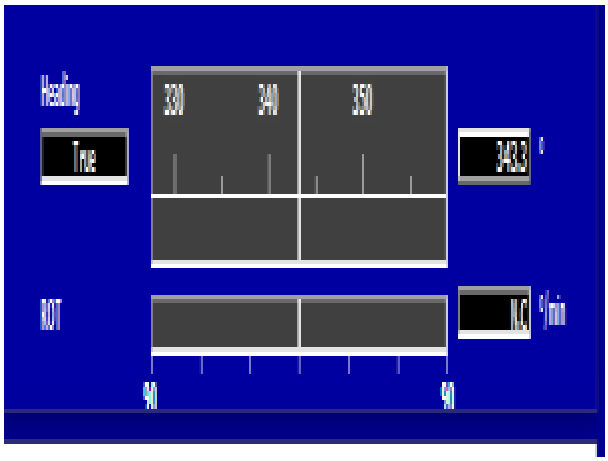
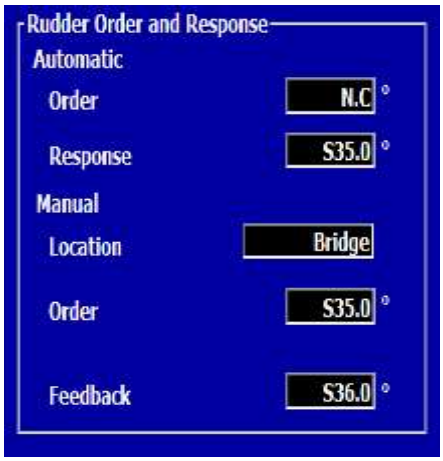
<tr><td> 
</td><td> 
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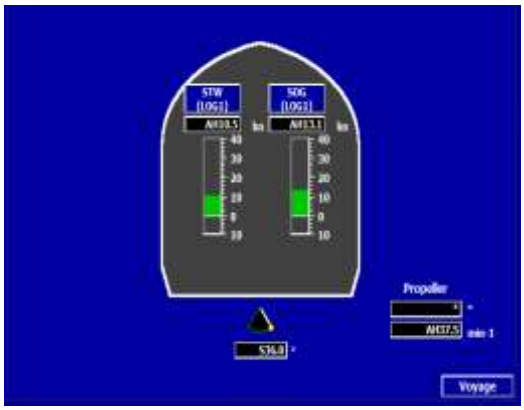
</td><td> 
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ECDIS 1

ECDIS 2


Date/Time: 23.03.2021/05:40 UTC
Event: Transiting Suez Canal

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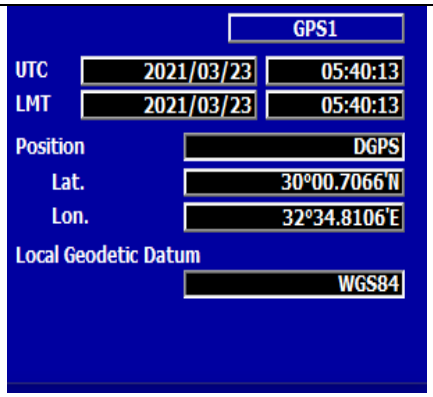
<tr><td> 
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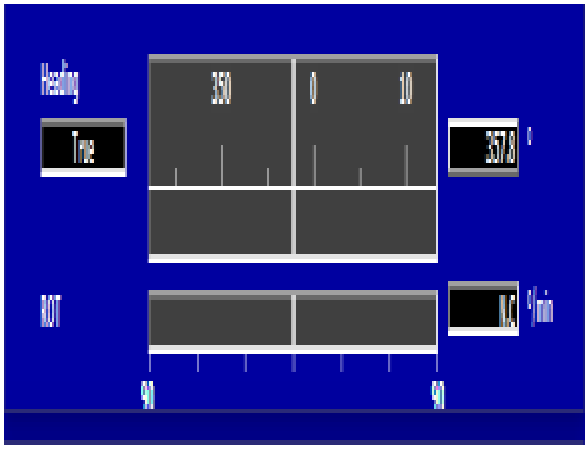
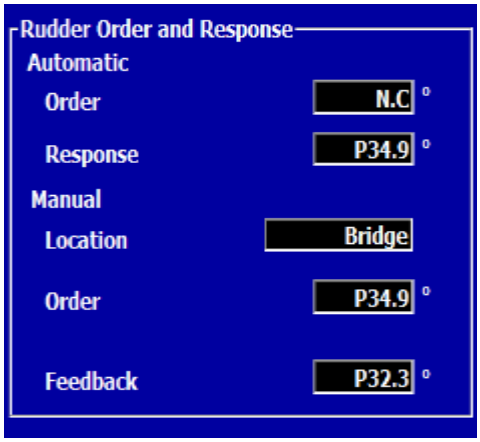
<tr><td> 
</td><td> 
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Navigation:
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• All data available from 00:00:00 UTC onwards.
• At 0511 hrs (UTC) entering Suez Canal</td></tr>
<tr><td>Key Issues</td><td>No any alarm</td></tr>
<tr><td>Important Event</td><td>None</td></tr>
<tr><td>Relat. Wind Direction/Speed</td><td>181°/10. m/s</td></tr>
<tr><td>Speed (STW)</td><td>10.6 kts</td></tr>
<tr><td>Depth</td><td>12.5 m</td></tr>
<tr><td>Heading</td><td>357.8°</td></tr>
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Date/Time: 23.03.2021/05:41 UTC
Event: Grounding

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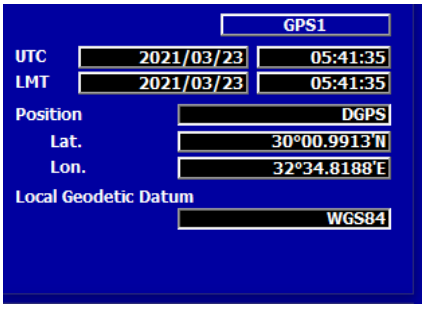
<tr><td> 
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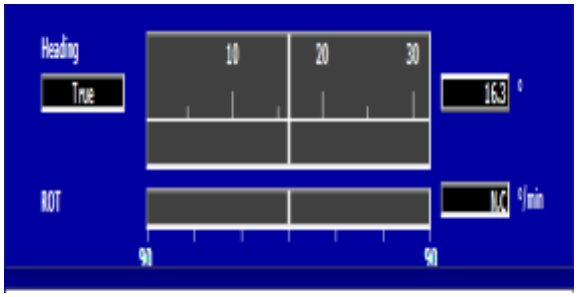
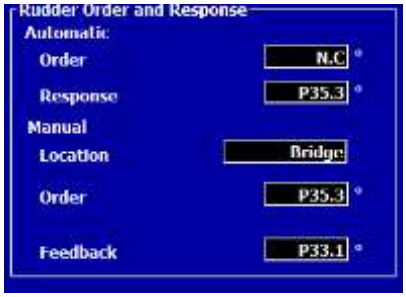
<tr><td> 
</td><td> 
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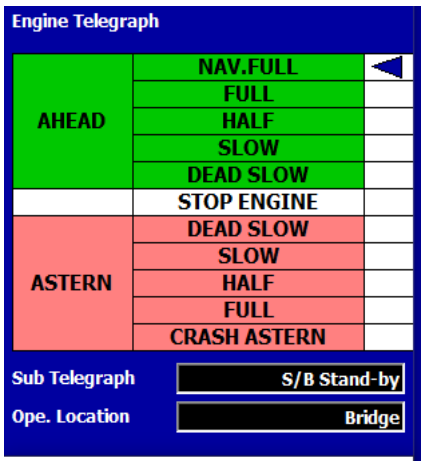
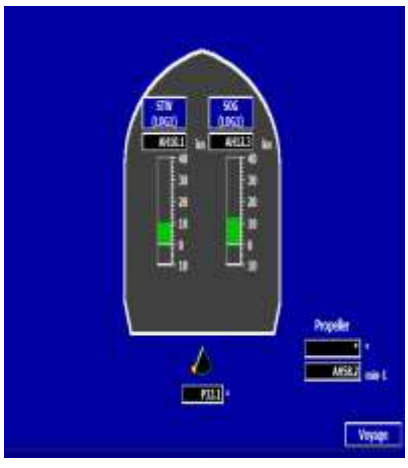
<tr><th>Engine Telegraph</th><th>STW/SOG</th></tr>
<tr><td> 
</td><td> 
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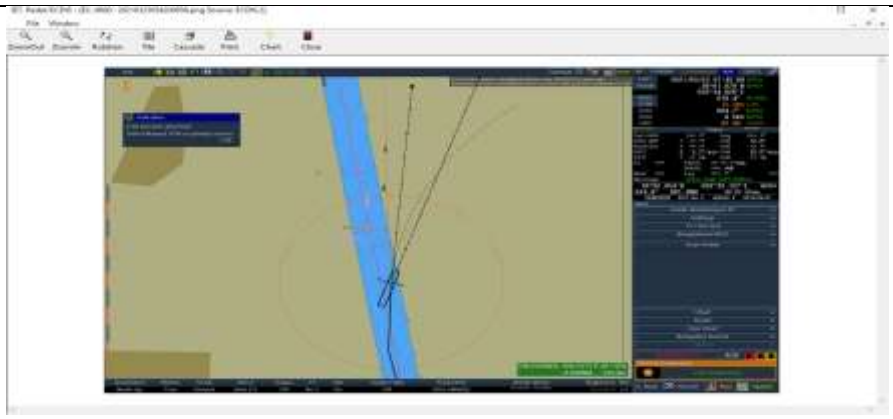
ECDIS 1

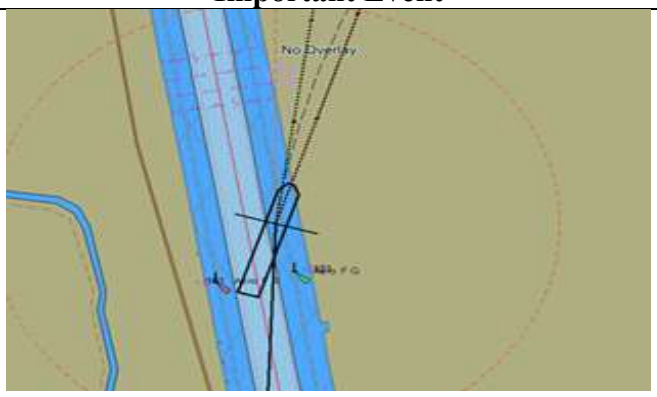
ECDIS 2



Analysis from: 05:40 hrs UTC, to 05:41 hrs UTC
Navigation:

- Recording started at 00:00:00 UTC
- All data available from 00:00:00 UTC onwards.
- At 0511 hrs (UTC) entering Suez Canal

Important Event



After the last swinging movement vessel runs **aground**

Key Issues	No any alarm Extreme Steering angles
Relat. Wind Direction/Speed	**152°/10.8 m/s**
Speed (STW)	**10.1 kts**
Depth	**2.5 m**
Heading	**016.3°**

6.2 Causes Theories:

According to the attending Flag casualty investigator, a multitude of reasons caused the outcome of casualty "(Ground of M/V EVER GIVEN on the eastern bank of Suez Canal) ". During accident inspection, VDR data analysis and physical inspection o/b, it was found that the vessel was free of navigational or mechanical deficiencies.

Consequently, the contributing factors were mainly the combination of meteorological conditions and human factors:

6.2-1: Wind Effect
6.2-2: Squat, Bank suction and Bank cushion effects
6.2-3: Navigation Decisions by Pilots
6.2-4: Intervention by Bridge Team
6.2-5: Pilot Roles

6.2-1: Wind Effect:

The wind on the Ever Given ship was a factor that directly affected the occurrence of the maritime accident, due to the fact that the ship has a large area exposed to the wind and the changing wind that was in the Suez Canal on the day of the accident. It caused the ship to have difficulties for proper maneuverability. Below is a summary of the changes in the intensity and direction of the wind from the access of the ship to the channel until the grounding according to the VDR data.

Time:	Direction:	Speed (m/s):
05:06	77°	4.4
05:11	100°	9.8
05:13	79°	10.1
05:17	84°	7.0
05:22	126°	8.3
05:25	155°	12.1
05:30	167°	9.0
05:34	204°	13.5
05:37	210°	13.9
05:40	181°	10.0
05:41	152°	10.8

TABLE 12: VDR DIRECTION & SPEED
(Source: Extracted from VDR data)

From the above table we can infer that from 05:06 to 05:30 the wind was with an incidence direction on the starboard side between the angle 77° and 167°, suddenly changed between 05:30 and 05:37 between the angle 167° to 210°, with an incidence on the port stern.

At minute 05:40, just before the grounding, it changed to a direction of 181° incident astern, to then suddenly change to 152° astern to starboard.

Based on the previous table, the average wind speed was 9.9 m/s, about 19 knots. Therefore, the continuous change in the direction and speed of the wind was a factor that contributed to the ship grounding.

6.2-2: Squat, Bank suction and Bank cushion effects:

Taking into consideration investigation evidence and the data recollected onboard this showed no malefaction and that vessel's steering gear, navigational equipment, and machinery were functioning efficiently at the time of the incident. Therefore, it is most probable that the vessel experienced the phenomenon of "bank rejection" – she was also probably experiencing "squat".

When a ship moves through restricted waters, it has to navigate close to the shore and other manmade structures because of limited navigable width. The shallow water and proximity of the sides of the channel effects the ship navigating through the restricted waters. These effects cause errors in maneuvering which can lead to grounding or collision. Any ship (regardless of its size) navigating through restricted waterways is heavily affected by hydrodynamic effects, Squat, Bank suction and Bank cushion effects.

Squat effect: When a ship moves through the shallow water, some of the water displaced rushes under the vessel to rise again at the stern. This decreases the upward pressure on the hull, making the ship sink deeper in the water than normal and slowing the vessel. This is known as squat effect, **which increases with the speed of the vessel**.

As the ship navigates in a narrow channel, the water between the bow and the nearer bank builds up a high pressure resulting in the bow being pushed away from the riverbank, the phenomenon is called **Bank Cushion**.

Similarly, due to low pressure at the stern of the vessel the stern is sucked into the riverbank, explained by Bernoulli's principle, and this phenomenon is called **Bank Suction.**

The combined effect of Bank Cushion and Bank Suction may cause the vessel to take a sudden and decided sheer towards the opposite bank as appears to have happened with **M/V "EVER GIVEN".**

If a vessel moves away from the center-line of a canal towards one of the banks, the flow of water between her side and the nearer bank becomes confined, and therefore lower pressure (greater suction) will occur on that side. This suction will tend to pull the vessel towards the nearer bank. However, it should be noted that these suction forces are not evenly distributed along the length of the hull and their resultant tends to act somewhere aft of amidships. This is equivalent to a force acting aft of the center of gravity which creates a turning moment, deflecting the ship's head away from the nearer bank. In practice this turning moment overrides the bodily suction towards the nearer bank and the vessel will start moving away from it, sometimes so violently that a sheer towards the opposite bank is generated."

Following diagrams from the Nautical Institute's "Shiphandler's Guide" shows that both squat and bank effect has a detrimental effect on steering.

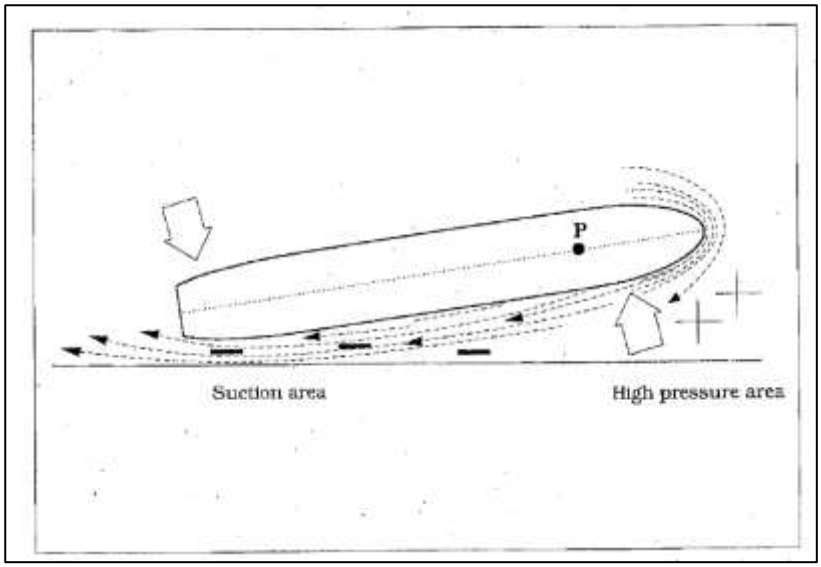


FIGURE 13: BANK EFFECT
(Source: Nautical Institute's "Shiphandler's Guide")

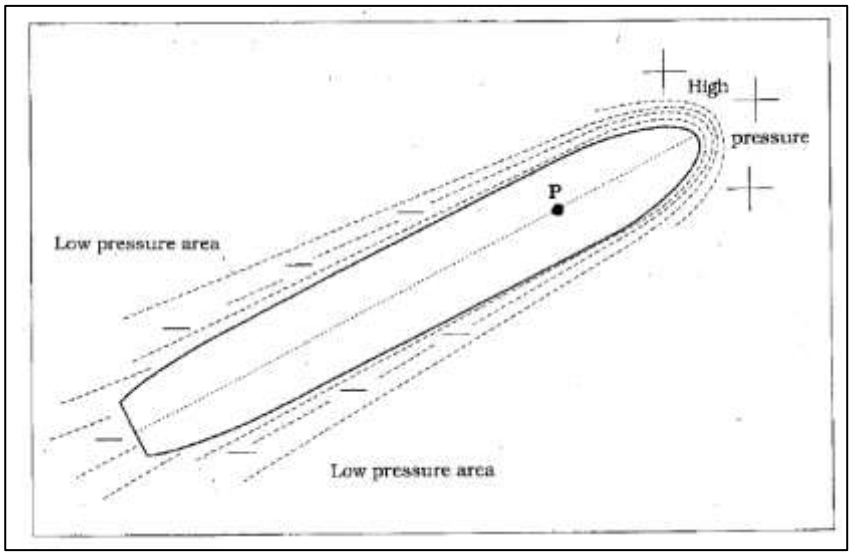


FIGURE 14: PRESSURE ZONES
(Source: Nautical Institute's "Shiphandler's Guide")

According to the crew statements, master's statement of facts and as illustrated in ECDIS play back and VDR data, **M/V EVER GIVEN,** at about **07:38 HRS / LT**, the helmsman reported that the vessel had stopped turning to port and was starting to turn to starboard. At the time, the vessel was close to the port bank of the canal and the speed had increased to about 13 knots over the ground. The vessel then started to turn quickly to starboard, away from the port bank, that was the time that a combination of squat and bank effect started to heavily effect vessel, due to high speed.

It should be noted that the speed of the vessel varies from 12 knots to 13,5 knots, and as per SCA regulation the speed should be about 8-9 knots.

6.2-3: Navigation decisions by Pilots:

There should be a sense of increased confidence for the bridge team when the pilots come onboard the vessel because the pilots bring local expertise/experience that reduces the risk of navigating in constrained waterways / narrow channels.

As per SCA regulation, the Pilots as advisors should indicate the best possible way to the Master, so that the ship can safely navigate. In the case of M/V EVER GIVEN, it was noticed that from the beginning of canal transit, the actions/orders Pilots were not the more appropriate, and not in line with best marine practice.

In particular, it was noticed that as per VDR:

- Pilots did not take into consideration the bad weather conditions, and consequently they have not requested assistance from tugs.
- The speed of the vessel was higher than the one recommended within Suez Canal procedures.
- Instead of course orders, they were given instructions "hard port / stbd", directly to helmsman.
- Although they tried to correct vessel position, from ECDIS playback it can been seen that from the entrance to the canal vessel had deviated from her intended course, "swing" effect.
- In their efforts to correct vessel position, they increase the speed not taking into consideration the effect of **Squat, Bank suction and Bank cushion.**
- Pilots took decision without any form of verification – possibly also because they were confident that the ship was outside any hazardous areas
- Pilots conducted the pilotage without requesting assistance from the Master, giving directly orders to the helmsman
- Pilots did not conduct any kind of verification / assessment of ship's position in relation to planned course
- Pilots did not realize the hazard of steer the ship off planned track and did not cooperate with the bridge team

Language difficulties can also add to problems associated with pilots and these should be considered. In the case of **M/V EVER GIVEN,** although Pilots orders were given in English language, the discussion between them was always in Arabic language, therefore the Bridge Team, could not understand pilots concerns (if any), the potential hazards, in order to on time and effectively conduct risk assessment.

When under pilotage, the ship is exposed to higher risks and a pilot's local knowledge should reduce these risks to an acceptable level. The pilot should be integrated into the Bridge Team and should not be considered as a replacement for a Bridge Team member.

Careful management of the pilot is vital, the bridge team should be in a higher state of alertness, since according to the SCA regulation, and the captain never loses command of the ship, even though the pilot is on board.

6.2-4: Intervention by Bridge Team:

The Master and the Bridge Team must always monitor the pilot's actions and ensure that they are properly integrated into the bridge team and intervene as necessary.

Additionally, it is recommended that the Captain and the pilots should determine in a meeting prior to starting the channel navigation who will indicate the direct orders to the helmsman.

In particular it was noticed that Master and Bridge Team:

- Although an adequate passage plan had been prepared and uploaded on ECDIS, the canal passing planned was not implemented, since vessel was off course, (not in the center of canal).
- Open and clear communication of risk between the Bridge Team members was missing.
- Although the captain intervened during the transist through the channel, these actions were not effective in preventing the stranding.
- The presence of two pilots rather than one may have convinced the Master that after all, they had better control over the evolving situation.
- The Captain, as the general responsible for the safety of the Ship, had to take command of the ship when the navigation was out of control, however, the control of the orders was always in charge of the pilots.

6.2-5: Pilots Role:

There is very often a contradiction regarding pilot's role and responsibility for the vessel when it is under pilotage. The Pilot's role is that of an advisor. He should give essentials advice about the manoeuvring of the vessel and place his experience and practical knowledge of the canal at the Master disposal. He should give only direct orders if the Master decides as such.

It has to be highlighted, that the Master and Bridge Team remain responsible for the handling of the vessel, with the Master giving orders to the helm and the engines. If the Master allows to the Pilot to give orders directly (this was the case on **M/V EVER GIVEN**), these orders are still considered as been carried out under the Master's sole responsibility.

As per Suez Canal rules, although pilotage is compulsory, the Master always retains responsibility.

(2) Pilot:
The duties of pilots commence and cease at the entrance buoys of Port Said and Port of Suez. He only gives advice on maneuvering

the vessel, course to steer, etc. He puts at the disposal of the Master his experience and practical knowledge of the Canal, but as he cannot know the defects or difficulties of maneuverability for every vessel, the responsibility falls completely upon the

Master. The pilot has to ensure that the vessel abides by:
a) The articles of the Rules of Navigation.

b) The orders of transit given by the Suez Canal Port Office.
The maneuver and orders are carried out under the direction of the

Master who is solely responsible for the ship. It is therefore for the master, taking into account the directions given by the pilot, to give the necessary orders to the helm, to the engines and tugs. If, in interest of quick maneuvers the Master thinks it preferable to allow the pilot to give orders directly, maneuvers carried out in

these circumstance shall be considered as having been carried out by the order of the Master and engage his sole responsibility.

E – Moving in Suez Canal Water without Pilot's Assistance:
(1) Unless explicitly authorized by the Suez Canal Authority, the following must be considered:

FIGURE 15: EXTRACT FROM SCA RULES
(Source: SCA Rules 2015, Section II, Art 11, Part D, Page 11)

6.3 Root Cause Analysis:

Analysis overview

During the navigation of the M/V Ever Given in the Suez Canal on March 23, 2021, a series of events and factors influenced the grounding of the ship; we can summarize them as follows.

The Root Cause of the grounding in the Suez Canal is the loss of maneuverability of the ship.

Factors:

- Wind speed, wind direction, squat, bank suction, and bank cushion effects were factors that influenced the development of loss of maneuverability and grounding.
- Indications of hard helm order instead of giving a course of steer by the pilots.

Events:

- Communication in the Arabic language on the bridge between pilots made it difficult for the captain and the bridge team to understand the situation in the Suez Canal transit.
- The master intervention in the orders given by the pilots to the helmsman, were not effective in preventing the grounding

7.0 Conclusion

On **23 March 2021**, the Suez Canal was blocked for six days after the grounding of **M/V EVER GIVEN**, a 20,000 TEU container vessel. The 400-metre-long vessel was struck by strong winds on the morning of **23 March 2021**, and ended up wedged across the waterway with its bow and stern stuck in the canal banks, blocking all traffic until it could be freed, at **29 March 2021.**

The conclusions of this report are as follows:

- The VTMS, Pilots and Master had not properly evaluated bad weather conditions especially strong winds and reduced visibility, as a risk condition for a VLCC vessel with a large area exposed to the wind.

- The vessel did not implement relative preventive measures against bad wheatear conditions (i.e. to be aided by tugboats as indicated int the Suez Canal rules Art, 58 escorting tug or even to postpone her Suez Canal transiting).

- The non-use of tugboats in a restricted area to better control the maneuverability of the ship, contributed to the occurrence of the grounding.

- The Pilots conducted the pilotage without requesting assistance from the Master, who was more familiar with vessel maneuvering characteristics.

- Although the captain intervened in the orders given by the pilot, instructing the helmsman to keep the ship in the middle of the channel, they were not effective in preventing the grounding.

- Bridge Team did not realize the vital importance of effective/efficient communication between the bridge crew and pilots. Discussions between Pilots in the Arabic language had, as a result, the rest of the Bridge Team, not understand pilots' concerns, and potential hazards, in order to time and effectively conduct a risk assessment, implement corrective actions, or even request assistance to the VTMS.

- According to the Suez Canal regulations, the captain has command of the ship at all times, and the pilot or pilots only fulfill an advisory role.

- According to the Suez Canal regulations, the permissible speed for ships is 8.64 knots, on average the MV Ever Given sailed at a speed higher than the permissible

- The squat & bank effect, the speed and the changes in the direction of the wind and the hard helm orders directly influenced the loss of maneuverability of the ship.

8.0 Recommendations:

There will be always risks for ***"vessel grounding"*** during transiting canals, however the appropriate preventing measures need to implement, in order to minimize risks and relative consequences.

Following preventing measures are recommended:

AA. Crew Training:

Master and Officers should be familiar with, and undertake relative training on:

1. **Company SMS sections for Navigations / high Risk operations (i.e. "transit canal).**

It is recommended that prior to any "Transit in the Suez Canal", the team leader (Master) should gather deck/engine officers to demonstrate, and explain the proper marine practice to enhance teamwork consensus and safety awareness, regarding navigation in this canal.

2. **Establish clear communication during Pilotage.**

It is recommended that the pilot and the captain, in the familiarization meeting prior to starting navigation in the Suez Canal, establish the language in which communications will be carried out, preferably English which is the commonly accepted language for onboard communications.

3. **Evaluate the Pilot's actions.**

It is recommended that the Bridge Team members must not be over-confident about the Pilot's abilities and skills. In some situations, the Pilot may not be familiar with the particular design of the vessel and maneuvering characteristics, which could lead to undesirable circumstances. Therefore, the captain must intervene if he considers it necessary, since according to the regulation of the Suez Canal, the role of the pilot is that of an adviser.

4. **Pay attention to the transit.**

It is recommended that the bridge team should monitor the Pilot's orders and ensure that all actions taken are timely, efficient, and effective. Additionally, the bridge team should try as much as possible and always take into consideration the pilot's advice, to follow the passage plan, which has been properly designed, thorough checks, and can provide valuable information, such as Abort points, safe transit speed, wheel over position, No go areas, contingency plans, etc.

5. **Pay attention to turns & the vessel's position.**

Proceed with utmost attention when the vessel is approaching a significant turn when transiting channels and with safe speed. Also, the vessel should be positioned at the center of the canal. This way, any potential bank effect will be reduced to a minimum, the vessel will be able to turn smoothly and there will be extra time to react in case of a navigational error. The rate of turn should never be greater than 10°/min.

BB. To the Company:

Although company SMS found adequate, properly implemented and maintained o/b, there should be always space for further improvement / development. Therefore, additional internal auditing is advised for operators / managers in order to evaluate the implementation / performance of company safety management system and ensure proper bridge management, in special case such as transit the canal.

The following preventive measures, which are related to the causes and contributing factors of the current serious maritime casualty, are recommended:

- Although it has been observed that the company implements a sufficient training system o/b, it will be reasonable to embrace specific training courses/titles regarding transit in the Suez Canal that could be considered to be part of the o/b training system.

- The Company should be notified in order to notify their whole fleet about "lessons learned" with an emphasis on the master's authority and responsibilities during vessel transit of the Suez Canal. It is essential to understand that the Master is always in command of the vessel and that the pilots only act as advisors.

- The company should implement training campaigns/seminars for the bridge team in order to highlight and explain the importance of squat calculations, the bank's impact on their fleet.

CC. Suez Canal Authority

It has to be highlighted that during the process of casualty investigation, very limited information/data was released/received from the side of the Suez Canal Authority. Taking into consideration the increased number and size of vessels that are crossing the canal, the risk of marine casualties/incidents within the canal is getting higher.

In view of the above Suez Canal Authority should consider reviewing its procedures and regulations, as well as training of Suez Canal pilots, in order to ensure vessel safety navigation transit within Canal and minimize the risk of grounding.

Following areas could be considered for further improvement:

1. As the marine industry, trends to build larger vessels, training of Suez canal's pilots with respect to maneuvering (within the canal) of large size vessels, as well as with the effect of wind especially to containers vessels, should be considered as mandatory.

2. Working language of Suez canal's pilots, especially when two pilots are o/b, should be imposed to be English. Discussions between pilots in Arabic language, with respect to navigation / maneuvering of vessel, does not allow Master (no Arabic speaking) to identify potential risks and implement corrective actions in time.

3. Taking into consideration frequency, similarity and consequences of marine casualties / incidents in Suez Canal, SCA should consider to implement a system of alerts notices and "lesson to learn" to the vessels transit the canal, as a preventive measure to minimize risk for re-occurrence as well as to reduce relative consequences.

4. SCA should consider as a mandatory requirement, prior a vessel transit Suez Canal, risk assessment conducted from vessel bridge team to be reviewed and approved from Canal Pilots.

5. Refreshment courses for Suez Canal pilots with respect to Squat, Bank suction, Bank cushion effects on different types of ships, that transit in the Suez Canal, as well as on canal characteristics (winds, currents, depth. etc.), should be considered to be conducted on regular basis.

6. SCA should develop and implement contingency plan procedures, including details for tug boat assistance, and same should be shared with Master and be included in Canal Suez transit risk assessment conducted from bridge team.

7. The bollard pulls of the tugboats available in the Suez Canal for salvage operation be appropriate according to the size of the vessel, especially for large ships.

8. SCA should ensure that latest Suez Canal regulation for navigation are published on SCA official website, obsolete documents should be removed.